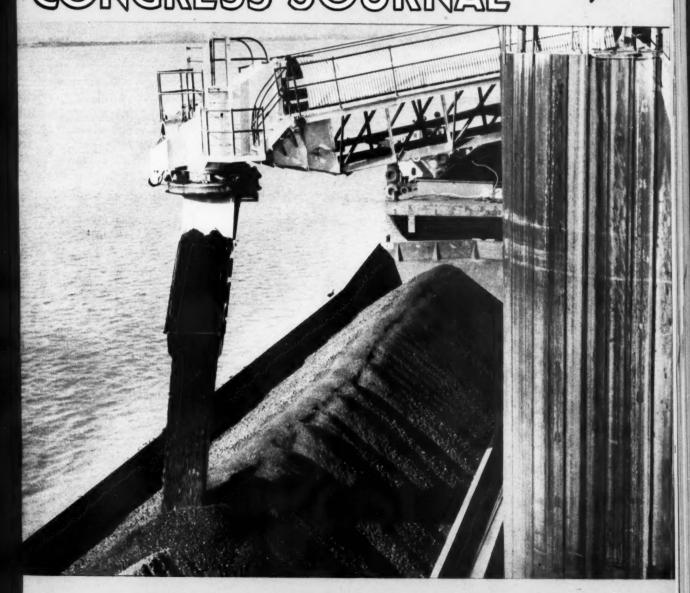
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FEBRUARY 1956





ANNUAL MINING REVIEW

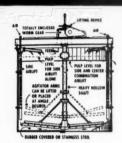
# STANDARD for LEACHING

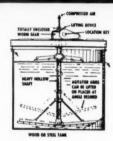
Stainless steel tanks for Denver Agitators made in Canada enroute to Sherritt Gordon Mines Limited.

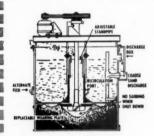
#### SHERRITT GORDON MINES, LTD. USES 28 Denver Side and Center Air-Lift Agitators showing method of pulp recirculation. Note many features that give trouble-free operation. DENVER AGITATORS

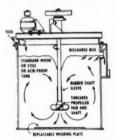
Sherritt Gordon uses 2 propeller type and 4 rake type DENVER Agitators at their Lynn Lake Concentrator and 16 propeller type and 6 rake type DENVER Agitators at their Fort Saskatchewan Refinery.

ALSO — There are 24 No. 30 (56 x 56) and 112 No. 24 (43 x 43) DENVER "Sub-A" Flotation Cells at Lynn Lake Concentrator producing nickel and copper concentrates.









Denver propeller type agitators meet many needs for conditioning, scrubbing or leaching. Threaded propeller hub and shaft make replacement quick and low-cost.

SPECIFY DENVER for DEPENDABLE 24-Hour Service

Printed in U.S.A.

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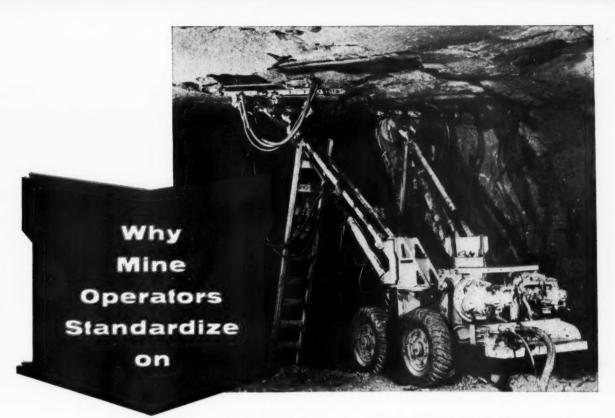


Our Experience Can Help You

The firm that makes its friends happier, healthier and wealthier"

Denver 17. Colorado

DENVER . NEW YORK . CHICAGO . SALT LAKE CITY . TORONTO . YANCOUVER . MEXICO, D. F. . LONDON . JOHANNESBURG



#### JOY DRILLMOBILES

In 1952, an underground copper mine operator purchased two Joy rubber-tired, self-propelled Drill-mobiles and two crawler-mounted jumbos of another make. Since then, this operator has standardized with the purchase of 20 additional Joy Drillmobiles. Here's why—

MOBILITY—To get high production in low-grade copper ore, this operator needed extremely mobile, highly maneuverable equipment. He got it in the fast-tramming Joy Drillmobile with tractor-type steering that makes it possible to turn around within its own length, to get into the tightest drilling locations and around short curves.

VERSATILITY—Drilling 32' wide drifts in a highly faulted ore body, where room height at times gets down to six feet, was no problem for the Joy Drillmobile. Mounting two extensible Hydro Drill Jibs with 12' long chain feeds, it was low enough to get into the lowest drifts and yet could drill horizontal holes at a height of 18'. The wide-spreading jibs permitted drilling the wide drifts from one set-up.

Consult a Joy Engineer

For AIR COMPRESSORS, ROCK DRILLS, CORE DRILLS, HOISTS and SLUSHERS, MINE FANS and BLOWERS

**FASTER DRILLING**—Air-hydraulic controls on the Joy Drillmobiles, featuring power-lift and power-swing, gave fast easy drill positioning. Drilling speed of the Joy T-350 Drifters mounted on the jibs was 16% faster than the drills on the other machines.

LOW UPKEEP COSTS—Maintenance costs for the Drillmobile including the Joy Drifters, at 1½ cents per ton, were considerably lower than the cost for the other machine and drifters.

The versatility of the Joy Drillmobile and the variety of models available makes it applicable to your mining plan. Write for more information today. • Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa. In Canada: Joy Manufacturing Company (Canada) Limited, Galt, Ontario.

Write for FREE Bulletin 21-3



WORLD'S LARGEST MANUFACTURER OF UNDERGROUND MINING EQUIPMENT



WAD M5853-21

Dart 140-TC truck with Allis-Chalmers 8DAS-1125 supercharged diesel being loaded by a shovel powered by an Allis-Chalmers 6DCS-1879 supercharged diesel.





Fifty-five ton Dart truck powered by Allis-Chalmers 8DAS-1125 supercharged diesel dumping over edge of spoil bank that is approximately 500 ft high.

#### **DIESEL ENGINES AVERAGE 5,000 HOURS BEFORE OVERHAULS**

Allis-Chalmers Buda Division truck engines powering 24 Dart and Euclid trucks help keep production flowing smoothly at the Bagdad Copper Corp. mine under extremely demanding conditions. These trucks work two shifts a day, six days a week, hauling out both overburden and ore. The haul covers about 7/10 mile, up a grade which starts at 12 percent and quickly increases to 18 percent, with five torturous switchback turns. Thick, abrasive dust adds still further to the grueling test.

Under these conditions the Allis-Chalmers engines have averaged over 5,000 hours of operation before their first overhaul. Many of them have given more than 20,000 hours of service since 1949, and are still "going strong."

Other Allis-Chalmers engines also take a hand in production even before the hauling stage. A large shovel powered by a Model 6DCS-1879 engine has loaded out more than seven million tons of ore since June, 1949. There are Allis-Chalmers engines on the drills, compressors and dozers.

Altogether, the performance of these big, tough engines has helped hold the over-all cost of moving ore and overburden to less than ten cents a ton. It will pay you to put productive performance like this under the hood of your trucks and other units. Write for complete details and the name of your nearest Buda Division dealer.

ALLIS-CHALMERS, BUDA DIVISION, MILWAUKEE 1, WISCONSIN

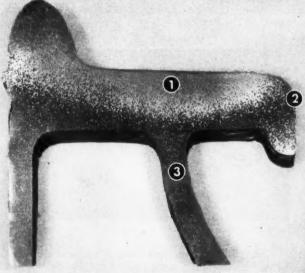
ALLIS-CHALMERS

Trucks at the Bagdad Copper Corp. mine, Bagdad, Arizona, haul overburden and ore up grades as steep as 18 percent and around five torturous switchbacks — a real test for any hauling unit and its engine.



# QCf "Load Support" MINE CAR WHEELS





Cross Section of ACF "Load Support" Mine Car Wheel showing: (1) uniform depth of hardening, (2) extra heavy overhang, and (3) support at center of tread.

#### Cost you less per tonnage-mile

New QCf "Load Support" Mine Car Wheels are perfectly round when you install them...and stay round after long, grueling service! Treads are QUICK CHILLED into a hard, abrasive-resistant surface and then GROUND CONCENTRIC TO THE AXLE to prevent "flats" and "load lifting". And because new type curved plates give treads FULL SUPPORT AT CENTER OF LOADING, tread "splitting" is practically eliminated. Overhang "break-offs" are eliminated also, due to extra metal reinforcement.

Although costs are competitive with ordinary wheels, New "Load Support" Mine Car Wheels result in fewer replacements... fewer work stoppages... long-lasting "roundness" that takes less power. They are available in 12", 14" and 16" sizes. These new wheels can really save you money... just like any  $\mathbf{Q} \cdot \mathbf{C} \cdot \mathbf{f}$  replacement part for your mine cars. Get the latest facts from your nearby

AMERICAN CAR AND FOUNDRY DIVISION, **Q C f**Industries, Incorporated. Sales Offices: New York · Chicago
St. Louis · Cleveland · Washington · Philadelphia · San
Francisco. Plants: Berwick, Pa. · Milton, Pa. · Huntington,
W. Va. · St. Louis, Mo. · St. Charles, Mo.

See you at the Coal Show (LEVELAND AUDITORIUM, May 16-19, Booth 1523

QCfmine cars
for Constant Haulage

#### how to get the most out of HOLLOW DRILL RODS

Modern drill rods — especially new alloy hollow drill rods like Crucible ca double diamond of 4E — give longer drill life than was possible with straight carbon rods. They'll give you lower cost per foot of hole drilled on the job. They will, that is, if you let them. For abuse will stop even the best steel from doing its best job. And you pay the price in higher drilling costs.

# Take, for example, MAINTENANCE:

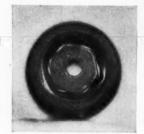
DRILLS — Pneumatic drills are often so badly in need of repair that good drilling is impossible.

Early failure of any rod used in these drills is inevitable. The solution is regular, periodic inspection of all drills and equipment — replacement of worn or damaged parts.

The damaged and worn striking faces of these pistons prevent impact from being transmitted to the rod in a straight line. Rod failure results.







**RODS** — It's a temptation to store drills by throwing them into one big pile. Resist it. For nicks and surface damage result – drill failures occur at points of damage.



Rods properly racked and stored give better service.

BITS — Keep bits sharp. A dull bit binds in the hole, and drills so slowly that little useful work is performed. But the drill steel must absorb the rugged blows of the hammer.



Proper bit maintenance pays off.

It pays big dividends to make good maintenance a habit. Quality drill steels, like Crucible ca double diamond or 4E Alloy Hollow Drill Rods, are made to give long service, lowest cost per foot of hole drilled. They're tough, strong, made to tool steel standards. This extra quality assures you of minimum rod breakage, fewer valuable bit losses. But to bring out the best in 'em, you've got to do your part by keeping equipment in shape.

Crucible hollow drill rods are always quickly available in the sizes and types you need. Crucible Steel Company of America, The Oliver Building, Mellon

Square, Pittsburgh 22, Pa.

CRUCIBLE

first name in special purpose steels

Crucible Steel Company of America



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By H. A. SAWYER

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# "You've got to roll it out for easy loading"



NON-EXPLOSIVE MINING METHOD

#### Cuts Costs 5 Ways

- Produces less fines in face preparation
- Rolls coal forward for faster, easier loading.
- Easier on "tender" roofs—cuts shoring, bolting
- Lowers cleaning costs by minimizing fines
- Reduces degradation—no shattered coal

And that's just what the gentle, heaving action of Airdox does. Coal is dislodged from the working face and pushed forward in a loose, easy-to-handle pile. There's no digging to do. This means faster loading and less wear and maintenance on mechanical equipment. Add to these advantages a drastic reduction of fines at the working face and it's easy to see why Airdox is the most economical means known for face preparation.

Very possibly an Airdox installation can bring these advantages to your mine. Write and we'll arrange a free survey.

#### CARDOX CORPORATION

#### . BELL BUILDING . CHICAGO 1, ILLINOIS

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Ottumwa, Iowa Phone: Ottumwa Murray 4-6564 Gardner-Denver... Serving the World's Basic Industries





# Reduce ore breakage costs by 50% to 75% with Gardner-Denver Deep Hole Drills

Permit ring drilling to 100 feet or more from a 7-foot development drift. Also for bench holes, stoping, slashing, pillar recovery.

Engineered deep hole equipment includes 4" or  $4\frac{1}{2}"$  drills, long feed aluminum

guideshells, Ring Seal Shank, sectional rods and couplings, bit adapter for carbide bits.

Send for illustrated bulletin on deep hole drilling . . . it's packed with application reports and equipment specifications.



#### **GARDNER-DENVER**

THE QUALITY LEADER IN COMPRESSORS, PUMPS, ROCK DRILLS AND AIR TOOLS FOR CONSTRUCTION, MINING, PETROLEUM AND GENERAL INDUSTRY

Gardner-Denver Company, Quincy, Illinois In Canada: Gardner-Denver Company (Canada), Ltd., 14 Curity Avenue, Toronto 16, Ontario



#### Ever see a stronger-looking drift?

Strength and safety rule supreme in this progressive ore mine, where Bethlehem's Yieldable Arch mine roof support is heavily employed. It's hard to imagine a cave-in or subsidence here!

The Yieldable Arch is formed of steel, which means it has both strength and durability. Each Yieldable Arch set consists of rolled-steel segments, heavily flanged to resist torsion and designed to nest into one another at points of overlap. Joints are made with U-bolt clamps drawn tight enough to hold fast

under normal loads. When unusually heavy pressures begin to bear down, the joints permit the nested segments to slide or yield before deformation of the steel can occur. The load is thus relieved and the structural integrity of the arch is maintained.

Horizontal braces or struts, secured to the arches by special J-bolt clamps, tie the arches together and contribute lateral stability to the structure. Lagging, such as the type shown in the illustration, is recommended wherever possible for maximum effect.

A Bethlehem engineer would like to discuss the Yieldable Arch in full detail with you, without any obligation on your part, of course. A visit to your workings would be helpful to him in making recommendations, and he will be glad to arrange such a trip at your convenience.

BETHLEHEM STEEL COMPANY BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation Export Distributor: Bethlehem Steel Export Corporation

#### BETHLEHEM STEEL



# How Dodge Manufacturing Corporation designs pillow blocks that pack more capacity in less space

THESE design features make Dodge-Timken pillow blocks ideal for use where big load capacity in small space is needed: (1) All-steel construction gives extra strength. (2) No space-consuming special thrust devices are needed, because the Timken® tapered roller bearings used take both radial and thrust loads in any combination. (3) Timken bearings have high load capacity because of their full line contact between rollers and races.

The Dodge-Timken pillow blocks shown below support all head, tail and take-up pulleys on this conveyor belt which transports ore from ships to railroad cars. Timken bearings take the shock loads because all rollers and races are made of casecarburized steel, with tough, impact-resistant cores under hard, wearresistant surfaces.

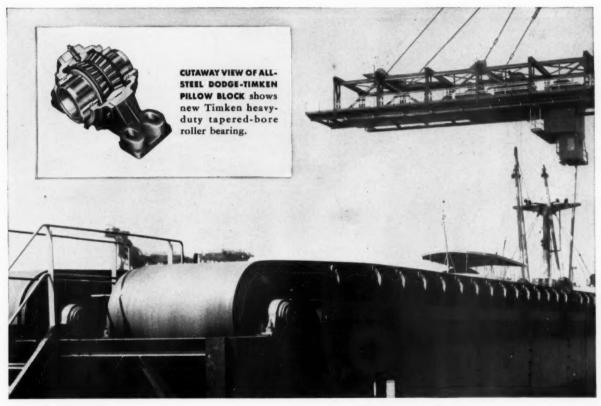
The Dodge-Timken All-Steel pillow blocks on this conveyor utilize a special new type of Timken heavyduty, self-aligning tapered-bore roller bearing. The pillow block is one of many expansion and non-expansion types made by Dodge Manufacturing Corporation for general power transmission and machine applications;

such as Type E, Double-Interlock, Type C and Special-Duty blocks. All are factory-sealed against abrasive dust and dirt.

Be sure you get all the advantages of Timken bearings when you buy or build pillow blocks, or any equipment. The Timken Company is America's only bearing manufacturer who makes its own steel. The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".



This symbol on a product means its hearings are the best.





TIMKEN
TRADE-MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS



DESIGN LEADERSHIP

The first Timken tapered roller bearing was produced in 1898. Since then the one-piece multiple perforated cage, wide area contact between roller ends and ribs, and every other important tapered roller bearing improvement have been introduced by The Timken Roller Bearing Company.

Only Timken tapered roller bearings have these advantages: 1. advanced design; 2. precision manufacture; 3. rigid quality control; 4. Timken fine alloy steels.

NOT JUST A BALL O NOT JUST A ROLLER THE TIMKEN TAPERED ROLLER BEARING TAKES RADIAL AND THRUST LOADS OR ANY COMBINATION

# team up JEFFREY SHUTTLE CARS and JEFFREY BELT CONVEYORS

for speedy, low cost coal transportation

A Jeffrey Class 66 shuttle car discharges coal directly into a Jeffrey 80-A belt conveyor at a large Kentucky mine.



#### Choose from these three classes of JEFFREY SHUTTLE CARS to match your mining height

They carry big payloads and haul the coal away fast. 4-wheel drive, 4-wheel steering and 4-wheel braking make them safe and easy to maneuver under every mining condition. All have hydraulically driven conveyor and cable reel. Conveyor can be run slow for "jogging" when loading, slow or fast when unloading, and its direction can be reversed.

Jeffrey shuttle cars are built for continuous, rugged service.



Class 68 in heights from 24" to 32"



Class 66 in heights from 30" to 48"



Class 67 in heights from 44" to 60"

## ...and BELT CONVEYORS to meet your exact requirements from the complete Jeffrey line

Three types of head sections can be combined with three types of frames, giving you nine combinations to meet any belt conveyor requirement. Jeffrey engineers will help you select the right combination for each gathering, slope or main line haulage job.

These three husky head sections can transmit from 25 to 160 HP for belt speeds from 150 to 600 FPM. Tandem drive puts the conveyor belt in maximum contact with two gear-meshed drive pulleys for most efficient use of power on a long pull.

The three frames are built for belt widths from 26" to 48", and idler roll sizes range from  $2\frac{9}{16}$ " to 6" dia.

With Jeffrey shuttle cars and belt conveyors, you are assured of high-tonnage handling at low cost, less downtime and low maintenance.

The Jeffrey Manufacturing Company

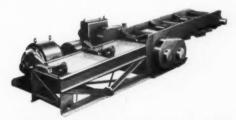
Columbus 16, Ohio



MINING • CONVEYING • PROCESSING EQUIPMENT TRANSMISSION MACHINERY • CONTRACT MANUFACTURING



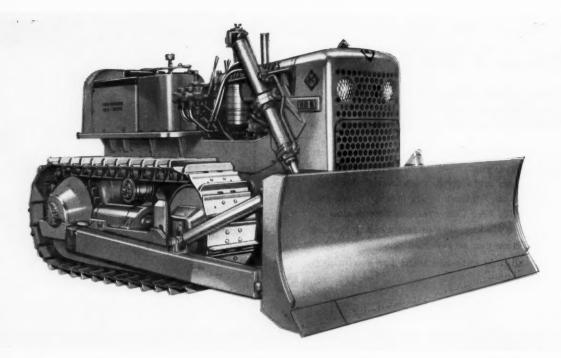
**52-B Head Section** for 25 to 75 HP motors. 52-B frames are made for 26", 30", and 36" belts, and 2%16" or 4" diameter idler rolls.



**64-A Head Section** for motors up to 125 HP. 64-A frames are made for 30", 36", and 42" belts, with 4" diameter idler rolls.



**80-A Head Section** for motor drives up to 160 HP. The 80-A frame is adaptable to 30", 36", 42" and 48" belts, and 4", 5" or 6" dia. idler rolls.



You're always sure of

#### TRUE ORIGINAL PARTS

from your Allis-Chalmers dealer



# SILION

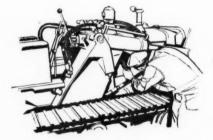
## but <u>not</u> forgotten by your Allis-Chalmers dealer

When you invest in Allis-Chalmers equipment, you are getting far more than just a modern machine. Your dealer offers you the opportunity to do a better job at lower cost. He wants your equipment to give A-1 performance day in and day out. His reputation depends on it.

That's why your Allis-Chalmers dealer puts so much importance on good preventive maintenance practices . . . encourages you to take full advantage of his modern servicing facilities.

and you can have confidence in his

# FACTORY-TRAINED MECHANICS, FACTORY-APPROVED METHODS



#### IN THE SHOP

Specialized facilities include factory-approved tools and all necessary equipment for complete service. Factory-approved methods are used to save you time and money, assure finest workmanship.



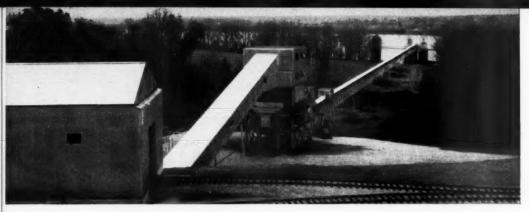
#### ON THE JOB

Factory-trained servicemen are ready to help you, day or night. Their technical know-how and practical experience get the job finished fast... at lowest possible cost to you.

ALLIS-CHALMERS, CONSTRUCTION MACHINERY DIVISION, MILWAUKEE 1, WISCONSIN

**ALLIS-CHALMERS** 





Only 9 men per shift are needed to operate \$1,300,000 Yankeetown Dock Corporation installation. F-M Diesel Engine, Caterpillar switch

engine, car tipper, breaker plant, 115 coal cars, gob truck and conveyor are lubricated with STANOLITH Grease MP.

#### This "3 in 1" Indiana coal mining group chooses STANDARD

Elva Nordhorn (right), assistant superintendent, Yankeetown Dock Corporation and Standard Oil industrial lubrication specialist Bill Griswold inspect car tipper. Bill Griswold is one of two experienced lubrication specialists in Standard's Evansville office who provide technical service. Bill is well qualified for the job. He has 30 years with Standard.



Two Indiana mines and their processing-shipping unit use STANDARD lubricating oils, fuels and greases; get three-way benefit.

Victoria and Wright Mines and Yankeetown Dock Corporation, in Southern Indiana, comprise one of the world's top-flight coal producing operations. This mining group delivers a million tons of coal a year to Clifty Creek power plant near Madison, Indiana. The power plant, in turn, produces electric power for an atomic energy installation nearby.

Both of the mines and the service facility depend upon Standard Oil Company for fuels, lubricating oils and greases. Across the page are three reasons why:

This 4 foot wide conveyor belt transports coal 1,105 feet from breaker plant to Ohio River loading dock. Loaded barges move up river to Clifty Creek power plant at Madison, Indiana. Conveyor system is lubricated with STANOLITH Grease MP. Conveyor operates two shifts per day the year 'round.





#### 1. Standard's experienced mine lubrication technical service.

Cn-the-spot lubrication technical service is provided the mines and dock by two experienced men from Standard's Evansville office. These industrial lubrication specialists know mine lubrication. They are backed up by technical help from the Standard Oil headquarters office and laboratories. Headquarters for the mines and dock are in Chicago, Kansas City, St. Louis and Indianapolis. Standard Oil has offices in these cities with industrial lubrication men on hand to give assistance whenever needed. Mine and dock operations thus receive complete lubrication technical service support.

#### 2. Standard's high quality and complete line of fuels, lubricants and greases.

Lubricants and fuels that keep equipment in service and minimize maintenance, contribute much to making this—or any—installation a profitable operation. The quality lubricants and fuels the mines and dock unit buy from Standard deliver top performance day after day, rain or shine, hot or cold, spring, summer, fall, winter.

#### 3. Standard's fast delivery and dependable service.

Warehouse facilities in Boonville, less than 5 miles away, serve the mines and dock. Stocks of recommended lubricants warehoused there, back up inventories at the site. Stock control holds requirements to necessary levels. Fast delivery from refinery assures an uninterrupted flow of required oils, fuels, greases; provides the mines and dock with the third big reason for buying from Standard.

Could your mine profit from services such as these provided by Standard Oil? Perhaps Standard fuels and lubricants could give a new look to your operations. Find out. Call your nearby Standard Oil industrial lubrication specialist. There is one near you in any of the 15 Midwest and Rocky Mountain states. Or write Standard Oil Company, 910 South Michigan Avenue, Chicago 80, Illinois.

Marion 5561 stripper removes overburden, Marion 151M loading shovel loads coal haulers at Victoria Mine. Two mines and dock operate as one integrated unit. Facility is one of the world's largest, most modern coal mining and handling systems.



One of Victoria Mine's 25 ton Euclid coal haulers unloads into waiting coal car. Trucks haul coal to railroad spur, railroad transports coal to breaker plant. Whole system uses Standard lubricants and fuels. At the Wright Mine pit, Marlin Carter (right), foreman, and Standard Oil lubrication specialist Oscar Daussman discuss lubrication. Oscar has been helping customers with lubrication problems all of his 30 years at Standard. Customers look to Standard for this kind of help.





STANDARD OIL COMPANY
(Indiana)







# Splice Any Size Trolley Wire Faster With This O-B Hollow Screw Splicer

- 2-piece hollow screw splicer design fits easily over trolley wire bends and burrs.
- Two different size wires are quickly, easily spliced together (takes only a minute to level them off with a file).
- Insures a smooth underrun with any size Figure 8, grooved, or No. 9 Section wire.
- Permanent holding strength up to 4000 pounds.

Order Catalog 22270.



Okio Brass MANSFIELD OHIO, U. S. A.

IN CANADA: CANADIAN OHIO BRASS CO., LTD., NIAGARA FALLS, ONT,

Feeder and Trolley Materials • Control Materials • Trolley Shoes Roof Bolt Shells and Plugs • Roil Bonds • Automatic Couplers



# O-B Bail-Type Shells and Plugs Speed up Bolt Installation "They Go Up Easy and They Stay Put!"

- Bail allows shell fingers to flex against hole wall, eliminating hangups in the hole and preventing bolt from falling out before wrenching.
- Factory assembly insures correct positioning of plug in shell for maximum expansion, maximum holding power.
- All units coated with rust preventive and shipped in husky cartons to reach the face just as they leave the factory.
- Available for 5/8-inch and 3/4-inch bolts.

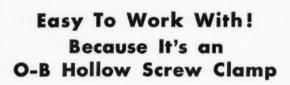
Left-Small O-B Bail-Type for %-inch bolts. (Catalog 22435)

Right-Large O-B Bail-Type for %-inch bolts, (Catalog 22463) and ¾-inch bolts (Catalog 22378)



IN CANADA: CANADIAN OHIO BRASS CO., LTD., NIAGARA FALLS, ONT.

Feeder and Trolley Materials • Control Materials • Trolley Shoes Roof Bolt Shells and Plugs • Rail Bonds • Automatic Couplers



- Easily accessible in hard-to-reach places because a hex wrench is the only tool needed.
- Two-piece body clamps around trolley wire, is held tight by two hollow screws.
- Slim jaws allow free passage of collector shoes without bumping or scraping.
- Low overall height (15%-inches) saves headroom.

Order Catalog 16227.

Okio Brass.
MANSFIELD OHIO, U. S. A.

IN CANADA: CANADIAN OHIO BRASS CO., LTD., NIAGARA FALLS, ONT.

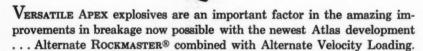
Feeder and Trolley Materials • Control Materials • Trolley Shoes Roof Bolt Shells and Plugs • Rail Bonds • Automatic Couplers



### Break it up to bite size...with APEX







Apex is an economical ammonium nitrate explosive with a patented assembly having a water-proof gelatin core that offers these advantages:

- The water-proof core promotes complete detonation of the explosive in wet holes.
- Complete propagation of the column in any height face.
- Fluted-end cartridge permits easy loading.
- A wide range of strengths and velocities to choose from. Apex is available in 8 strengths: each in low, medium and high velocity.

For maximum breakage, better control of throw and economical production, team APEX explosives with the ROCKMASTER Blasting System.

For complete information on all Atlas Explosives Products, ask your Atlas representative for a copy of the new Atlas Explosives Catalog.



#### ATLAS EXPLOSIVES

"Everything for Blasting"

ATLAS POWDER COMPANY, WILMINGTON 99. DELAWARE

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#### **BEST FOR MAIN DRIVE MOTORS AND GENERATORS**



#### Best Because:

- "National" Brushes provide maximum commutator stability.
- "National" Brush grades are specifically designed for machine-operating characteristics.

#### Use These Grades:

to meet all service requirements.

\* SA - 45

#### Here's Why:

"National" Brushes meet the widest variations in the following operating conditions.

 Current densities Commutator surface speeds Atmospheric contamination

Always consult your National Carbon Representative when selecting brushes. He is there to serve you with the best and most complete line of brushes for mill and mine operations.

The term "National", the Three Pyramids Device and the Silver Colored Cable Strand are registered trade-marks of Union Carbide and Carbon Corporation

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Headquarters for the BROWNIE LINE of Hoists-proved in scores of mines!

Our Brownie Line helps you select the right hoist to meet your requirements. It's the industry's most complete linerigging hoists, room hoists, haulage hoists, car-spotting hoists, layer loading hoists—hoists for every haulage use. Be sure you obtain the right hoist to meet your requirements. Outfits, Gathering Pumps and Pump Accessories, Blowers, Brownie Rerailers and Derailers. BROWN-FAYRO DIVISION, Sanford-Day Iron Works, Telephone 3-4191, Write P. O. Box 1511, Knoxville, Tenn.



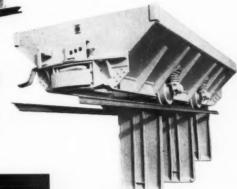








A big capacity 4-wheel S-D AUTOMATIC is shown at right. Designed and built for extra years of service —  $\frac{1}{2}$ " plate in the doors, for instance. Level full capacity 277 cu. ft. Surcharge capacity 338 cu. ft. Might be the car you need.



#### Market for mine cars

Below is another big capacity 4-wheel 5-D AUTOMATIC. Negotiates 50 foot minimum radius curve when coupled. Note overlapping ends, permitting continuous belt loading without spillne between cars.

IS THERE SOMETHING special you need in mine cars—a feature to meet your particular requirements? You probably will find the answer in our plant. Down through more than 50 years of car building experience we have solved the major problems of mine haulage.

Regardless of the type car you need, we build it . . . cars so constructed to give you more years of service with the least maintenance. Shown here are but a few of scores of all types S-D Mine Cars regularly being built for coal mines. All are designed and constructed to give superior service for the lowest dollar. Whether you need one car or 101, don't hesitate to get one of our engineers into your mine—face-to-face with your problem. With this type of cooperation, plus our facilities and capacity to build any type mine car of any size, any haulage problem in your mine can be solved. SANFORD-DAY IRON WORKS, Telephone 3-4191, P. O. Box 1511, Knoxville, Tenn.





An S-D 8-WHEEL AUTOMATIC with four bottom dumping doors. Others have been designed and built with six doors. These 5-D eight-wheelers also feature exclusive S-D "Twin Safety Latches" and "Safety Seal" against dust leakage.

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KNOXVILLE

MINE CARS, All Types - PRECISION WHEELS - "Brownie" HOISTS CAR RETARDERS - SPOTTERS PUMPS - OIL SPRAY SYSTEMS

TENNESSEE

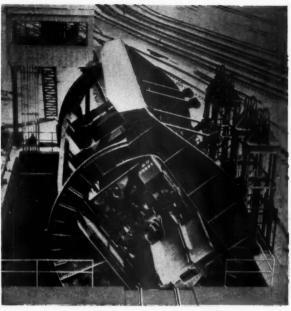
From Design to
Successful Operation...
You can depend on

Heyl & Patterson

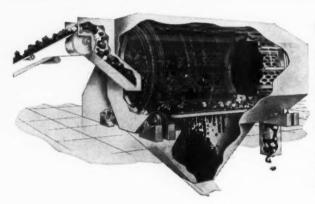
#### For Heavy Materials Handling Equipment

74 & P Rotary Car Dumper

For handling up to 120-Ton Capacity Hoppers or Gondola Cars, these completely automatic one-man operated dumpers can be built in 2, 3 or 4 clamp design. The Automatic Car Clamps may be



operated by mechanism contained on the Dumper itself or by counterweights. Optional features include Car Retarder on platen and platen-mounted scales.



#### 74 & P Bradford Coal Breaker

It serves as a preliminary coal cleaner relieving preparation plants or power plants of handling the large impurities in the raw coal. The Breaker shown has Open Ends equipped with steel tires which run on four rollers mounted on axles with anti-friction bearings. It can also be built as a Trunnion type. The Breaker can be of gear-driven design or as shown . . . driven by a motor through a gear reducer and a chain transmission to the periphery of the Breaker.

#### HEYL & PATTERSON EQUIPMENT FOR THE COAL INDUSTRY

Bradford Coal Breakers Car Dumpers: Rotary Railroad Rotary Mine

Coal Crushers
Conveying Systems

Mine Car Handling Equipment Preparation Plants Refuse Disposal Cars Reineveld Centrifugal Dryers Thermal Dryers
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#### Wire Rope by MACWHYTE

MONARCH WHYTE STRAND Wire Rope is at home on today's fast, high-output equipment where heavy duty performance means savings.

There is a correct MONARCH WHYTE STRAND size and construction for all mining needs. Give it an opportunity to serve you—you will be more than pleased with its performance.

Prompt shipment from stock can be made by Macwhyte distributors.

MACWHYTE COMPANY, 2952 Fourteenth Avenue, Kenosha, Wisconsin

Manufacturers of wire rope to meet the needs of all equipment: Internally Lubricated Wire Rope, PREformed Wire Rope, Braided Wire Rope Slings, Aircraft Cable and Assemblies, Monel Metal, Stainless Steel, and Plastic Coated Wire Rope, and Wire Rope MILL DEPOTS

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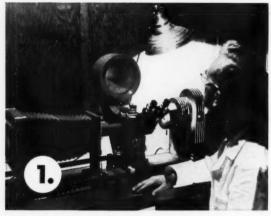
Ft. Worth 1, P. O. Box 605 Portland 9, 1603 N. W. 14th Ave. St. Paul 14, 2356 Hampden Ave. Los Angeles 21, 2035 Sacramento

General Wire Rope Catalog G-16 available on request.

MACWHYTE WIRE



# Tuffy Tips



# 1. Metallographic Examination. Under powerful magnification, Union Wire metallurgists examine the microstructure of the steel in rods and wires to see that rigid specifications are met and maintained in processing.

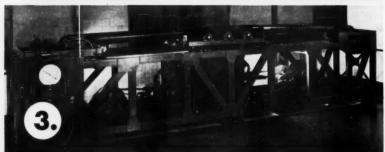
2. Chemical Analysis Laboratory. Steel for Union Wire Rope is made to rigid specifications. Here rods and wire are chemically analyzed to make certain that the correct combinations of carbon, manganese, etc., are kept under control.

# Here Are Some Of The Steps Taken To Pre-Determine Tuffy Toughness And Assure Longer Rope Life

- 3. Designed by Union Wire Rope Engineers. This accelerated fatigue tester is equipped with sheaves from 8" to 24" permitting application of any bending stress. Tensile loads up to 12,000 lbs. are applied. Thus wire rope life under toughest fatigue conditions is pre-determined.
- 4. Rope Testing Machine. This 3-story high machine is designed to test and record the breaking strength of the rope when finished and ready for the customer.
- 5. Static Flexibility Tester. The demand of machinery engineers toward smaller sheaves and higher speed made it necessary for Union Wire Rope Engineers to adapt this standard machine in order to test static flexibility.

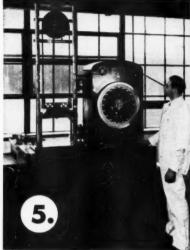
- 6. Wire Tensile & Torsion Tester. In tension and under torsion, this machine tests wires to see that they measure up to the extraordinary high level of strength and toughness mandatory in Union Wire Rope.
- 7. Another View Of Accelerated Fatigue Tester. Shows simultaneous testing of three different wire rope constructions. Here, in days, ropes are subjected to punishment equal to weeks or months of hard service.
- 8. Wire Fatigue Testers. The fatigue strength of wire rope is the sum total of the fatigue strength of the wires in its construction. Here, the wires in tension and bending are tested for fatigue strength.

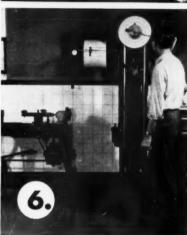




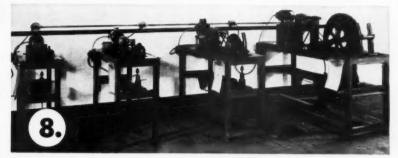


#### How Research Puts Longer Service Life Into WIRE ROPE









### When you specify one of the **Tuffy** Wire Ropes, you can say **Tuffy** and forget complicated specifications



#### Tuffy Dragline

Has the built-in extra stamina, flexibility and abrasive resistance needed for longer service in rugged mining work. Helps move more material per rope.

#### 7 Tuff 9 - par fabric ible

#### Tuffy Slings

9 - part, machine braided wire fabric construction is extra flexible, extra strong. Resists looping, kinking. Straightens without material damage.



#### Tuffy Slusher Rope

Rigid, non-collapsing to eliminate drum crushing. Elastic and flexible to take shock loads and to better withstand abrasive wear in tough slusher loading.



#### Tuffy Scraper Rope

Flexible enough to withstand sharp bends, yet stiff enough to resist looping and kinking when slack. Plenty tough to fight off drum crushing. On easy-to-mount reels.



#### Tuffy Dozer Rope

Designed to take the punishment of small winch drums and small sheaves . . . the shock of blade manipulation under toughest going. In 150' reels for easy mounting on dozer.

#### Your Tuffy Distributor Works For You

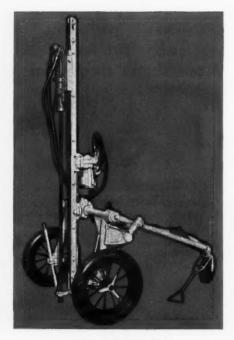
He's the man who can help you find a fast answer to all your wire rope problems. He's also the man who often knows as much about some requirements of your equipment as the men who made it. He's the man who's eager to supply the kind of service that will hold your patronage. Feel free to call on him anytime.



Specialists in high carbon wire, wire rope, braided wire fabric, stress relieved wire and strand

Cut down man hours! Speed up hole drilling!

# 2 new more powerful Thor wagon drills!



#### THOR SW-1

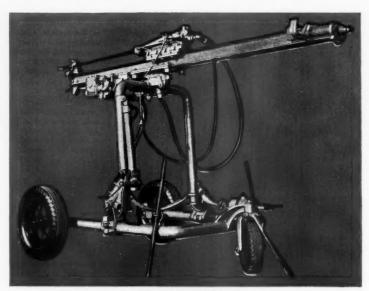
Compact size-3 wheel reinforced rig . Weight with model 75 drifter—768 lbs. • 2 handle controls movable along mast . Handles up to 31/2" bore drifter . New centralizer swings out of way for close drilling . Mast swings 360° vertical or horizontal . Wet or dry operation



#### General purpose SW-1 • Heavy duty BW-2

Now Thor offers two new wagon drills to fit every drilling requirement wagon drills which will outperform and out-last other models. Drill holes in any direction, at any angle, on level or sloped ground. One

man operation cuts costly man hours. Check these features on the new heavy duty BW-2 and the general purpose SW-1 and then call your Thor contractors tool distributor for a free trial of the model that fits your job.



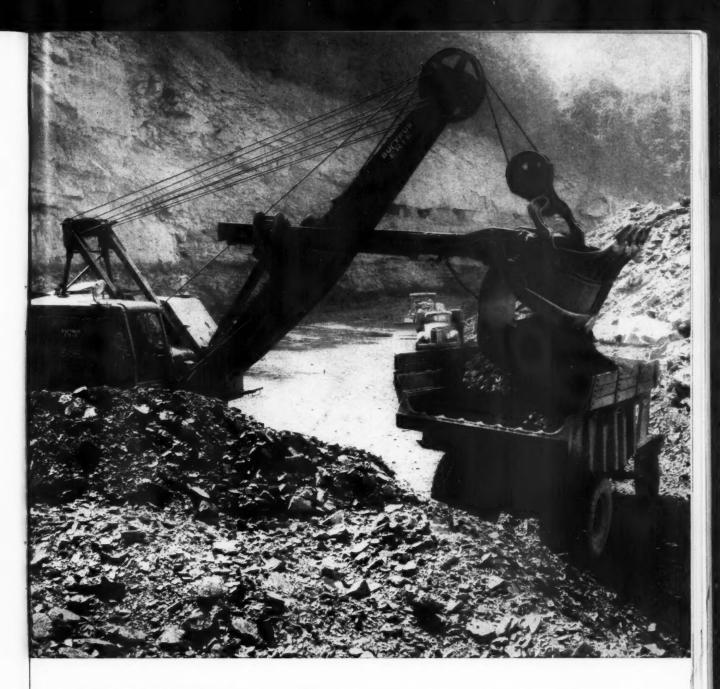
THOR BW-2

5 h.p. rotary air motor • 3 wheel reinforced heavy-duty rig • Variable speed control . Motor and controls movable along mast . Wet or dry operation . Mast swings 360° vertical and horizontal. New centralizer swings out of way for close drilling . 800 to 1000 lbs. pulling power for steel removal . Spring buffer prevents chain breakage . Equipped with Thor 105 drifter. (4" bore)

#### THOR POWER TOOL COMPANY, AURORA, ILL.

Long Island City, N.Y. San Francisco
Philadelphia

Export Division, **New York City** 



# IMPOSSIBLE WITHOUT EXPLOSIVES

On a mountainside in West Virginia, overburden up to 80 feet in height—sandstone, shale, and slate—is blasted with the correct type of Hercules® dynamite to uncover seams of coal 7 ft. thick. Speedy, economical shovel-loading operations are maintained by loosening the coal with small charges of explosives.

Hercules has long pioneered in developing explosives for every type of project. Our experience and service facilities can help you solve blasting problems in mining, quarrying, construction, seismic explorations—wherever explosives are needed to get a job done.

#### HERCULES POWDER COMPANY

Explosives Department, 922 King Street, Wilmington 99, Delaware Birmingham, Ala.; Chicago, Ill.; Duluth, Minn.; Hazleton, Pa.; Joplin, Mo.; Los Angeles, Calif.; New York, N. Y.; Pittsburgh, Pa.; Salt Lake City, Utah; San Francisco, Calif. HERCULES

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ORIGINATORS OF THROW-AWAY BITS; MANUFACTURERS OF BARS, BITS, CHAINS AND OTHER PRODUCTS FOR COAL MINING; CUSTOM MACHINERY DESIGNERS AND BUILDERS; HEAT-TREAT SPECIALISTS; SALES AGENTS FOR THE CINCINNATI ELECTRIC DRILL.

#### **BOWDIL BITS**

#### **NEW I-29 CONCAVE**

Patented concave design increases bit clearance, assures longer wear without increased power consumption. Made from special steel, rolled, with concave faces. Tests in hundreds of mines have proven these Bits last 15% to 20% longer. Bowdil makes the right size and shape bit for every mining condition, to fit all types of chain.

#### **NEW CARBIDE TIP BITS**

No. 1-27N3 No. 1-27N5





Superior in design and construction, with great strength and rigidity in the shank and clamping method.

PHOTO BY WM. VANDIVERT FOR WEST KENTUCKY COAL COMPANY IN COOPERATION WITH BITUMINOUS COAL INSTITUTE.



BOWDIL CUTTER BARS

are designed for extra strength and

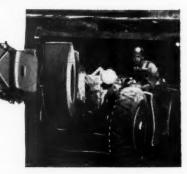
power saving. Rivet-free body, Z bar construction, wide wearing

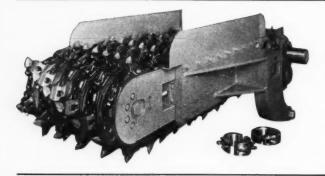
strips make it the sturdiest bar in mining. Bowdil Bars are standardized to fit all mining machines.

#### **FABRI-FORGE CHAIN**

Rugged, easy to maintain, the dropforged lug body stands up under heavy wear with breakage practically eliminated. A major improvement is the true-running radial track guide.

NOW AVAILABLE WITH BIT OPENING 1/2" x 1" (takes all type bits)





#### **NEW 6-IN-ROW RIPPER HEAD**

Using 6 renewable independently adjusted Cutterbars, with all 6 Chains similar in kerf and lacing arrangement for interchangeability. All 6 spockets interchangeable. Improved design head drive shaft and sprocket assembly using 2 piece sprockets to maintain extreme tension to the shaft.

These are only a few of the features and advantages in this modern Ripper Head for Continuous Mining. Ask a Bowdil representative or write for more detailed information.



#### SPROCKETS FOR ALL MINING MACHINES

Bowdil Sprockets are made from special heat-treated alloy steel and designed for hard wear. Our stock of over 100 different styles includes clutch, spline and keyed types—various tooth designs of 4 to 13 teeth.

#### WANT SOMETHING SPECIAL? BOWDIL CAN BUILD IT

Bowdil has the staff and facilities to work with you on any custom building or rebuilding, engineering, machining, fabricating. Excellent heat-treat equipment. If you have a problem, bring it to Bowdil.

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# Kaiser Steel Corp.

#### speeds mine clean-up with Tournatractor

#### 1 rubber-tired rig replaces 2 crawler-tractors

Working their Eagle Mountain Iron Mine, Eagle Mountain, California, Kaiser Steel Corp. find they get more clean-up work done faster with 1 Model C Tournatractor than if they assigned 2 crawler-tractors to handle the same job. The new tractor-on-rubber replaced one full-time crawler, and does the part-time plant and pit maintenance work formerly assigned to a second track-type machine. The change to the faster, more maneuverable 208 hp Tournatractor enables the mine to keep haul units moving with less delays due to spillage or uneven pit floors.

#### 3 to 4 times faster than crawlers

Tournatractor handles all clean-up assignments around 3 shovels. It shuttles back and forth at speeds up to 19 mph, which is 3 to 4 times faster than the top speed of any crawler. In addition, reverse speeds to 8 mph allow unit to back away quickly without interfering with load-

ing operations. Big 21.00 x 25 low-pressure tires provide plenty of flotation and traction. They stand up well despite abrasive and rocky footing around pit floor.

#### Also used for pulling and pushing

In addition to clean-up and bulldozing, the 208 hp tractor pulls air compressors to drilling sites and moves the frame supports which

Tournatractor also cuts downtime for air compressors and other equipment when moving them from one location to another, Tournacarry electric cable for shovels, drills, and other equipment.

#### Get all the facts

Mine owners around the world are taking advantage of the ease of maintenance, durability, speed, and high production of the Tournatractor. If you are interested in these same benefits for your mine, get all the details from your Distributor today.

Tournatractor—Trademark Reg. U.S. Pat. Off. T-828-M-b

tractor gets on the job quicker . . . gets to the next assignment quicker, 1500 ft. is less than a minute away.





LeTourneau-WESTINGHOUSE Company

Peoria, Illinois

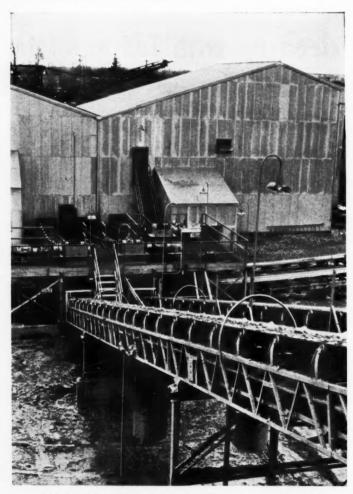
A Subsidiary of Westinghouse Air Brake Company

# LOWER COST PER TON-MILE

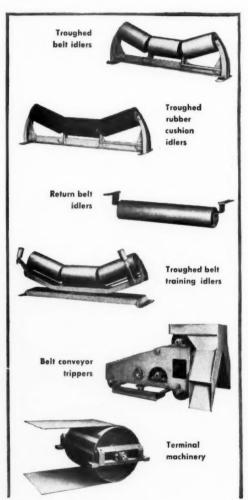
# ...yours with either a Link-Belt single belt conveyor or complete system

Whether you need a single belt conveyor or complete system, you'll find that Link-Belt engineering and equipment add up to lower cost per ton mile. Drawing from vast experience, our engineers can develop a system incorporating the most practical components from our complete line of quality idlers, trippers, drives, terminal machinery and other items. And if desired, we will handle erection.

Link-Belt has pioneered the development of belt conveyors for short or long hauls . . . indoor or outdoor service. To learn how this background can produce utmost economy per ton-mile in handling your bulk material, call your Link-Belt office.



Link-Belt 30-in. wide belt conveyors handling iron ore concentrate and tailings from washing plant to railroad and truck loading hoppers.



Link-Belt offers you one source for all equipment—including 500 idler sizes in 35 types... plus pulleys, drives, trippers and supports. Whatever the weight of loads, atmospheric factors or other operating conditions, you're assured of the easiest and most practical integration of belt conveyors into your overall system requirements.

### LINK B-BELT

#### BELT CONVEYOR EQUIPMENT

LINK-BELT COMPANY: Executive Offices, 307 N. Michigan Ave., Chicago 1. To Serve Industry There Are Link-Belt Plants and Sales Offices in All Principal Cities. Export Office, New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville, N.S.W.; South Africa, Springs. Representatives Throughout the World.

## IN GRINDING MATERIALS

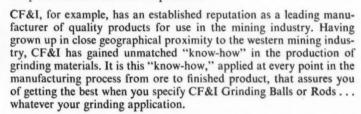


# your best buy is





... AND HERE'S WHY: All grinding balls look alike, and cost pretty much the same. This holds true for grinding rods, too. This being the case, the best way to buy is on the reputation of the manufacturer and the performance record of his products.



As for product performance, CF&I Grinding Balls, forged from special analysis steel, have an ideal balance between toughness and hardness ... are well known for their optimum grinding ability and wearability. And CF&I Grinding Rods, also made from special analysis steel, machine straightened, and with square-cut ends, have an established reputation for efficiency and economy in grinding operations.

Whatever your grinding material needs, it will pay you to consider CF&I Grinding Balls and Grinding Rods. Contact your CF&I representative to discuss your requirements.



THE COLORADO FUEL AND IRON CORPORATION

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#### MARIONS IN COPPER

This is one of more than 40 Marion machines at work for one owner in one of the biggest producing copper mines of the world. It is a 7 yard Marion 151-M, designed for continuous service in the world's heaviest digging.

MARION POWER SHOVEL CO. • MARION, OHIO

# PATENTED ENGINEERING FEATURES of Wilmot Automatic Coal Cleaning Units

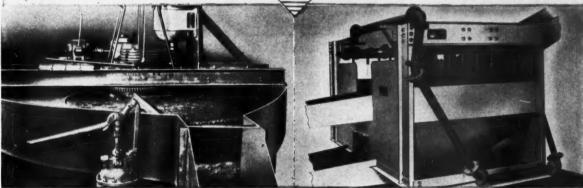


WILMOT CONE CLEANER --Fully automatic; visible-audible signals. One man maintains a battery. Cleans bituminous in suitable stages from 31/4" to 0; anthracite, Stove to No. 4.

WILMOT FROTH UNIT (below) -- For fully automatic recovery of marketable fines from sludge; uses less oil; 1/8" to 0.

WILMOT CLASSIFIER CLEANER -- Cleans bituminous (1/8" x 0), anthracite (-3/64" x +48 mesh).

> \*WILMOT-OCC HMS VESSEL (below) -- Unprecedented simplicity: unique hydraulic motor, integral with drive shaft, eliminates all power transmission trains; only one moving part in the vessel.



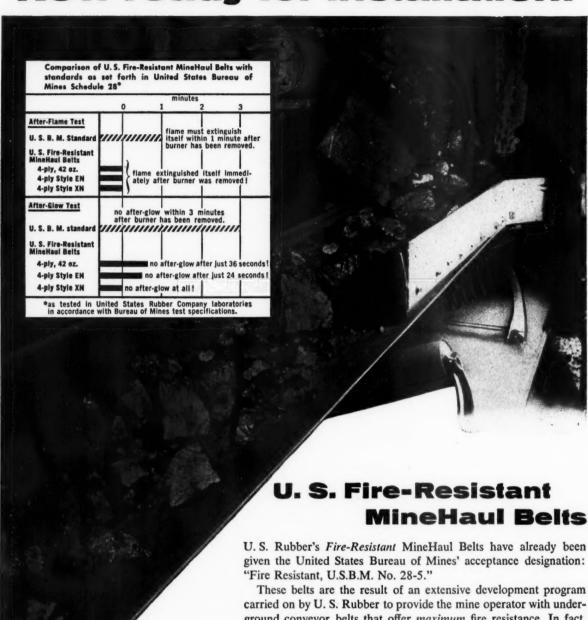
#### Complete Units for Every Purpose

Long a leader in applying automation to the control of labor costs and product quality, Wilmot coal cleaners, with their patented automatic controls, furnish a

near approach to push-button operation. Models in all sizes. As constructors of complete preparation plants for over 40 years, we offer a wealth of experienced engineering. Use our laboratory and pilot plant testing services.

WILMOT ENGINEERING CO. HAZLETON: PA. Plant: WHITE HAVEN: PA.

## Now ready for installation!



U. S. Rubber's Fire-Resistant MineHaul Belts have already been given the United States Bureau of Mines' acceptance designation:

These belts are the result of an extensive development program carried on by U. S. Rubber to provide the mine operator with underground conveyor belts that offer maximum fire resistance. In fact, the new U. S. Fire-Resistant MineHaul Belts EXCEED the Bureau of Mines specifications, as the chart above shows.

And, naturally, these new belts have all the added features built into all "U. S." conveyor belts: optimum troughability, high impact resistance, outstanding rip resistance, excellent fastener holding ability, added edge protection-to name a few.

Contact any of the 27 strategically located "U. S." District Sales Offices or write us at Rockefeller Center, New York 20, N. Y.

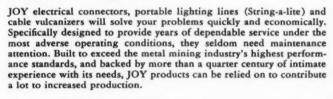


**Mechanical Goods Division** 

Inited States Rubber

Worried... over production losses caused by excessive electrical maintenance?

# Cheer Up!



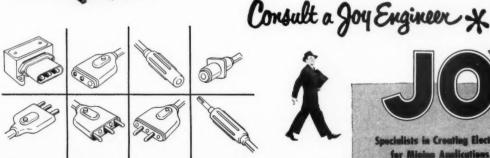
ELECTRICAL PLUGS AND RECEPTACLES . . . More JOY electrical connectors are used in mining operations than all other brands combined. Vulcanized to cord or cable as one-piece Neoprene jacketed units, they can't crack or lose shape when struck hard blows . . . are moisture and dust tight . . . and require no pampering to provide a long life of safe, efficient service. Hundreds of styles and sizes are available for mining needs. So for production's sake, remember JOY when you need electrical connectors . . . and in the meantime ask for your copy of Bulletin B56.

PORTABLE LIGHTING LINES (String-a-lite) ... No special tools or talents are needed to hook it up or take it down. Can be quickly lengthened, shortened or moved to meet the exact needs of any working or passage area. Supplied in one-piece factory molded sections of 2 to 10 light outlets that inter-connect through JOY male and female "end-plugs" to make up the complete string. Choice of five socket and two end plug designs. Several styles of mating power receptacles also available. Bulletin B52 provides complete details.

CABLE VULCANIZERS . . . for rubber, Neoprene, Buna S and thermoplastic jacketed cables. Simple in operation, JOY vulcanizers quickly pay for themselves by making it possible to repair cuts and breaks in vital portable power lines immediately. Two types are available-"Steam" and "Direct Heat." Both are heated electrically with automatic temperature controls. Bulletin B48a describes these vulcanizers in detail and lists molds vs. cable sizes. Ask us for your free copy.

#### JOY MANUFACTURING COMPANY

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# Here's the New Reverse The Reverse The Reverse The Reverse The New Pere's the New

that sets a new high in 15-ton Rear-Dump Performance!



**DUMPS FAST AND CLEAN** 

Smooth body interior and tapered rear chute assures clean shedding of the load well back of the rear wheels—an important feature for dumping into hoppers or over the edge of waste banks. Lycoming Silica Sand Co. in Pennsylvania has used 15-ton "Eucs" for years and now has added two R-15 Rear-Dumps to their hauling fleet.



STAY ON THE JOB LONGER

Victorville Lime Rock Co. in California uses 2 Model R-15
"Eus" for hauling rock and overburden. Rugged body and frame withstand the impacts of loading, hauling and dumping heavy excavation in construction, mine and quarry service.

Built for heavy off-the-highway service, 15-ton Rear-Dump "Eucs" have paced the field for over 20 years. They've reduced hauling costs on hundreds of the toughest jobs in mine, quarry and construction work... delivered "plus" performance year in and year out.

This model R-15 incorporates the engineering advances, the easy operation and maintenance features, resulting from unequalled field experience with other Euclid Rear-Dumps of the same capacity. It provides the dependable work-ability that means more payloads per day at lowest cost per ton or yard moved.

Have your Euclid dealer give you full details on this new 15-ton Rear-Dump and the complete line of Euclid earth moving equipment. He'll be glad to show you why so many users have proved for themselves that Euclids are your best investment.

EUCLID DIVISION GENERAL MOTORS CORPORATION, Cleveland 17, Ohio The R-15 is your BEST BET for Lower Hauling Costs!

Advanced design results from 20 years of leadership in



Some of the
OUTSTANDING
FEATURES
of the R-15

- 10½ yd. body 30,000 lb. payload
- 218 h. p.
- loaded top speed of 25 m.p.h.
- hydraulic booster steering
- air assist clutch
- free floating springs
- 14.00 x 24 drive tires (16.00 x 25 optional)



#### POSITIVE CONTROL OF DUMPING

Double-acting 3 stage Euclid hoist and hydraulic system gives the operator fast, positive control of the body position at all times. Dumping angle of the body, in fully raised position, is 68°. Body, frame and hoist are designed and built as an integral unit. McDowell & McDowell are using six R-15 "Eucs" to haul heavy excavation at a big plant site job in Nashville, Tennessee.



#### SPEED AND STABILITY

The 5 speed transmission and Euclid planetary axle provide a top speed of 25 m.p.h. with full 15 ton payload...27 m.p.h. with 16,00 x 25 tires. Free floating Euclid spring suspension gives maximum stability empty or loaded under all road conditions... permits faster safe travel speeds. Dale Bloom had a fleet of 6 Rear-Dump "Eucs" on this Kansas Turnpike job—2 of them the Model R-15.



#### EASY OPERATION

Full width cab offset to left for maximum vision, air assist clutch, booster steering, 218 h.p. engine, fast acting hoist, free floating springs and fully adjustable seat contribute to driver comfort and easy operation. Four of these new Rear-Dumps worked on a highway relocation job of W. J. Menefee Construction in Missouri.



Euclid Equipment



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Export Representatives: ARMCO INTERNATIONAL CORPORATION Middletown, Ohio

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# SHEFFIELD



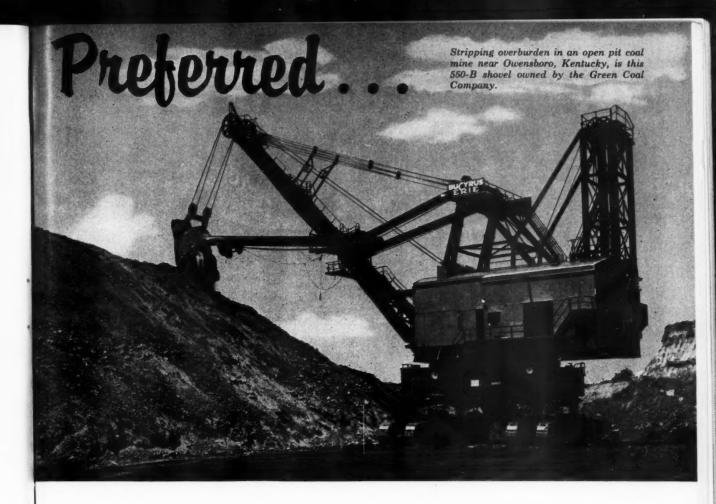
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Grinding Balls

for Over 20 Years!

# SHEFFIELD STEEL DIVISION

ARMCO STEEL CORPORATION
SHEFFIELD PLANTS: HOUSTON . KANSAS CITY . TULSA



# FOR ECONOMICAL, BIG-VOLUME STRIPPING

It is dependable high output that makes Bucyrus-Erie stripping shovels and draglines first choice wherever high overburden ratios threaten economical coal recovery. Their range, capacity, speed and reliability come from sound design and durable construction made possible by Bucyrus-Erie's unequalled experience in building excavating machinery of all sizes and types.

Records show that most of the major output-increasing developments in coal stripping equipment have been introduced by Bucyrus-Erie. Today the popularity of its stripping shovels and walking draglines is good indication that leadership has been maintained. Get the full details from those who know — owners and operators themselves — and find out how Bucyrus-Eries can set new production records on your stripping jobs.



# BUILT FOR ROCK-HARD ROAD WORK

# The Allis-Chalmers HD-21 is a Real Miner's Tractor

Chiseling an access road through rock demands "something extra" in crawler tractor performance and durability, yet it's the kind of job any miner's tractor may be required to do.

Conditions like this call for an Allis-Chalmers HD-21. Its 204-hp Allis-Chalmers engine is noted for its ability to perform with a minimum loss of efficiency even after thousands of hours of operation. Torque converter drive multiplies torque up to  $4\frac{1}{2}$  times . . . develops 41,500 lb drawbar pull at low speeds

. . . cushions the entire power train against load shocks.

New Tru-Dimension tracks bring a new high in track durability. Thousand-hour lubrication intervals save maintenance time. Positive seals protect idler, support roller and truck wheel bearings from abrasive wear as no other seals can.

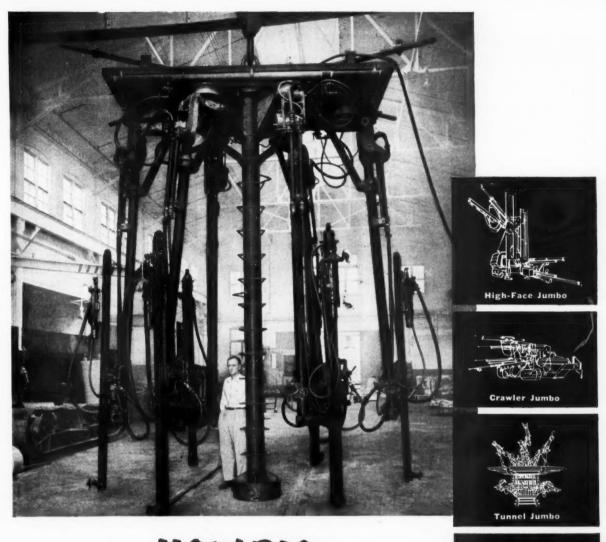
Ask your Allis-Chalmers dealer to show you the many other features that make the HD-21 a natural for rock-hard assignments.

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**ALLIS-CHALMERS** 





# no matter **HOW BIG** or how small the drilling job

you can do it faster and easier with an I-R

HYDRA-BOOM JUMBO



THE giant, octopus-like drill jumbo above was supplied by Ingersoll-Rand for a large shaft-sinking job. Carrying six heavy, boom-mounted I-R drills, each with individual, fingertip control, it is lowered down the shaft as drilling progresses — virtually eliminating setup time and giving maximum footage per shift.

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bos, manufactured by Ingersoll-Rand Co. are shown above right and illustrate the unlimited flexibility of these fast-acting, hydraulically-operated drill mountings. Use them on large jobs or small—for smooth, effortless hole spotting. Let us help you engineer your unusual drilling problems. For the complete, cost-saving story, write today for Bulletin No. 4162.

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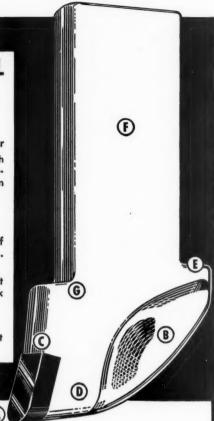
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#### **New improved KENNAMETAL** cutter bit design offers many features

- A Hard carbide tip for longer cutting wear B "I-Beam" construction adds strength
  - while providing greater cutting clearance, especially for circular action cutters

Thinner web . . . less steel to grind

- Ideal top angle for cutting clearance
- Good carbide support, with plenty of steel to back-up carbide tip . . . prevents breakage
- Self-gaging shoulder . . . prevents bit from being forced back into the block and damaging chain
- Shank styles to fit all popular chains
- Knock-out shoulder . . . speeds up bit changes when needed



# All KENNAMETAL\* Cutter Bits now of new, improved design . . . rugged "I-Beam" construction

Always a leader in cutter bit improvements that help bring out more coal faster, Kennametal has redesigned the complete line of Kennametal cutter bits. These improved cutter bits have now been in use in the mines for several months, undergoing most severe tests under almost every conceivable cutting condition . . . medium, hard and tough. They have been used in just about every cutting duty . . . on Joy, Jeffrey, Goodman, Compton, McCarthy Rotary and other machines. Results indicate the new design fills the need for even greater coal production capacity with fewer interruptions for bit sharpening or replacement. Thus, cost per ton of coal is reduced.

Have you tried these improved Kennametal Cutter Bits in your operations? If you have not, ask your Kennametal representative to show you these bits. Then test them in your mine. Kennametal Inc., Mining Tool Division, Bedford, Pennsylvania.

Ask about complete line of KENNAMETAL cutter bits, drill bits, roof bits, augers, pinning rods, accessories



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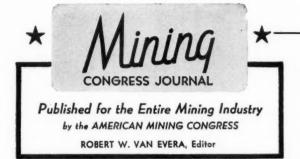


### **KENNAMETAL'S** new cutter bit design provides:

- greater cutting efficiency at higher loads and speeds
- longer bit service
- fewer bit changes
- fast bit changes when required
- lower power consumption
- less machine downtime
- less machine maintenance
- lower percentage of extreme fines
- thus, higher production and reduced cost per ton of coal

#### There is a KENNAMETAL cutter bit for every cutting condition





Volume 42

FEBRUARY, 1956

Number 2

#### Time Is Money

A NEWS item on page 159 announces a significant management development in keeping with current industrial trends and requirements.

The Oliver Iron Mining Division of United States Steel Corp. has established industrial engineering departments at each of its three Mesabi range dis-Two factors in the Oliver announcement reveal that considered foresight went into this move. First, the fact that the new departments will function directly under J. E. Machamer, vice-president of operations in Duluth, shows that the work will proceed from a high administrative level, unhampered by the temporary problems of production. Second, the key personnel in each department have been specially selected from the district operating staffs, each from the same area where he will serve as industrial engineer. Thus every man in the organization is aware that his industrial engineer has a full appreciation of the pressures incident to mine operating. These two considerations solve at the outset some problems that have plagued industrial engineers since the profession first stepped out on its own.

A training program was set up by this leading iron ore mining company shortly after World War The company's experience in technical job training may well be the factor that permits drawing the new engineers from the operating staff and apparently there is complete confidence that these production men can be satisfactorily trained in the techniques of the industrial engineer. Though the stop-watch is a vital tool and the symbol most often associated with the profession, it actually carries no more significance than the stadia-target does to the mining engineer. We suspect that these men will familiarize themselves with automation, production control, quality control, linear programming, statistics, predetermined time systems, incentive standards and administration, work measurements, work simplification, and many other practices-even including industrial relations.

The final test is not how well these men digest the mechanics of these various processes, but rather in their ability to pick the proper technique to apply to the job at hand. In mining, more than almost any other industry, men work extremely close to Nature. A factory may be built from scratch in nearly any favorable location. It can be large or small, refined or rough as economic conditions dictate. But a mine must accept the conditions of location, size, and quality that are inherent in its orebody, so the industrial engineer in mining has a rough job. The opportunities open to him, on the other hand, are almost unlimited. As a management aide he is an effective tool to help the executive perform the tasks that are becoming increasingly intricate and time-consuming.

Management talents are searce and often must be spread too thin. Industrial engineering departments contribute much to correct this ill. They help make the executive's moves count by properly preparing him to make a decision correctly on the first try. In addition industrial engineering combined with operating experience provides a training ground where prospective managers may learn to think in both the broad and the detailed scope that may be required of them in later years.

The application of industrial engineering concepts in formalized departments is certainly not new in the mining industry. Many leading producers have been doing it for years. The coal industry has shown great interest in the subject, and the American Mining Congress recognizes this by devoting a whole panel at the forthcoming Cincinnati coal convention to industrial engineering.

#### The Mountaineer

A SALUTE to the Hanna Coal Co. on completing and putting to work its new 60 cu yd shovel, the Mountaineer. This is the largest unit of mobile land machinery ever constructed. We don't mean to revere bigness as such; rather we raise our hat to the faith that these industrial leaders have demonstrated in the future of the coal industry and in their ability to surmount tremendous technical problems. The machine has been under construction since October 1954, and the factors which prompted the decision to go ahead with it must have been thoroughly studied for some time previous to that.

On considering that more than  $2\frac{1}{2}$  million dollars are wrapped up in the *Mountaineer* and that a year ago the coal industry was not characterized by the general confidence that exists today, we feel that all the men in the vast team of managers and technicians of many levels and specialties from the Hanna Coal Co., the Marion Power Shovel Co., General Electric Co., and many other concerns have a large personal stake in this machine. This is the kind of fortitude that brings real progress.

# Annual MINING REVIEW

# Bituminous Coal in 1955

Production Bounces Back but Industry's Ability to Expand Output Quickly has been Drastically Reduced

By GEORGE A. LAMB

Manager of Business Surveys Pittsburgh Consolidation Coal Co.

BITUMINOUS coal production during 1955 is estimated at 465,000,000 tons, 73,000,000 tons above 1954, and the best output since the Korean War year of 1952.

This improved coal market reflected the peak activity that featured business generally in the United States and abroad. Moreover, it may also have reflected something more—the start of a new era of gradual growth for bituminous coal among the mineral fuels.

Bituminous coal was 70 percent of the total energy supply during World War I, but began to decline relatively thereafter as oil and natural gas broadened their markets. It was 50 percent of the total energy in World War II, after which it dropped steadily, reaching 27.5 percent in 1954. Bituminous climbed back to 29.5 percent in 1955 although both oil and natural gas expanded their sales to record figures. This increase in itself, however, is considered as marking the turning point rather than providing the reason for coal's brighter outlook.

Bituminous has lost most of what it could in markets where it was more vulnerable to oil and gas competition. Railroad fuel accounts that exceeded 100,000,000 tons annually only seven years back are about gone as the carriers near complete dieselization. There has been a heavy liquidation in space heating and certain other sales. Coal's remaining customers, however, are expanding; they use solid fuel to advantage, and their purchases are more than offsetting the shrinking Electric utilities have markets. doubled their coal consumption since World War II to become the largest coal user, and their fuel needs will enlarge. Steel, the second largest coal consumer, plans for steady growth. Many companies in the manufacturing field will need more coal as they build additional capacity.

#### U. S. Consumption Increases

Preliminary data show that the 1955 consumption of bituminous was 420,000,000 tons, a gain of 57,000,000 tons or 16 percent over 1954. This relative gain compares favorably with the 11



The bituminous coal industry is reviewed by GEORGE A. LAMB who has been with Pittsburgh Consolidation Coal Co. as manager of business surveys since 1946. He has been a member of various coal industry committees and also served as consultant to the Cabinet Energy Committee in 1954 and with the Office of Price Stabilization in 1951. He was assistant director of the U. S. Bureau of Mines during World War II.

percent increase in total industrial activity as measured by the Federal Revenue Board index.

Electric utilities used 140,000,000 tons or 25,000,000 tons more than in the previous year. Forty percent of this gain took place in the East North Central states, the important industrial area consisting of Ohio, Indiana, Illinois, Michigan, and Wisconsin. This area, located adjacent to the leading coal fields, generated approximately one-fourth of the country's power. Another large increase in coal burn took place in the East South Central states, where the TVA has its

Mining Congress Journal is proud to present this Annual Review of the mineral industries. The year just ended was an important one and we are indebted to the authors who have reported and analyzed its events.

plants and is rapidly increasing its steam generation.

The steel and coke industries consumed 112,000,000 tons, 22,000,000 over 1954. Steel operated at near capacity in 1955 following a comparatively low operating activity the year previous. Other industrials had a 9 percent increase in coal use as the railroad and retail purchasers had declines.

#### Exports

Exports totalled 50,000,000 tons in 1955, 19,000,000 tons higher than in 1954, coming about principally because of the surprising increase of 18,000,000 tons in overseas shipments. Exports to Canada amounted to 17,000,000 tons, up 1,000,000 tons.

The 33,000,000 tons of overseas ex-

ports moved to all parts of the world but largely to Western Europe. Leading buyers were Great Britain, Western Germany, Italy and the Netherlands. Two million tons were shipped to Japan.

Countries in Western Europe and in other parts of the Free World have been short of fuel since World War II. In past years, this shortage was met in part through financial assistance by the United States. With world business activity advancing to record levels, however, these foreign countries are financing their own fuel purchases. As a result, American coal exports in 1955 were mainly upon a commercial basis, and some believe this will be the case during the years ahead, which will add stability to what had been a highly uncertain market.

#### Stocks

Consumer stocks amounted to 69,000,000 tons at the start of 1955 and showed little change by the end of the year. This is the opposite of 1954 during which stocks were drawn down with the result that production fell below the consumption-export total.

#### **Competitive Fuels**

Residual fuel oil and natural gas industrial sales increased in 1955 but principally in areas removed from coal's main markets. With respect to sales to electric utilities located east of the Mississippi River residual had a slight drop while gas declined 20 percent. Thus, coal bettered its relative position as a supplier of raw energy to the utilities during a year in which power production increased substantially.

The price on residual fuel oil advanced during 1955 as a strong world demand developed for this product. In New York Harbor, the price on this heavy oil reached \$2.65 per barrel in August and held at this figure during the rest of the year. This price was 50 cents per barrel higher than the one that prevailed in the summer of 1954, an increase equivalent to over \$2.00 in terms of a ton of coal. This higher price caused residual sales to slump in coal competitive areas, but they increased in total because of the greater need for residual in markets where coal is not a factor.

The larger burn of residual was supplied through increased imports as production of residual in U. S. refineries enlarged but slightly. Preliminary figures show that residual imports averaged approximately 400,000 barrels daily in 1955, or 13 percent



Productivity approximated 10 tons per man-day for the industry, an increase of 60 percent since 1948

#### BITUMINOUS COAL CONSUMPTION AND EXPORTS

| ,,                              | 1954                                     | 1955                                     |
|---------------------------------|--|--|
| Electric utilities              | 115                                      | 140                                      |
| Steel and coke                  | 90                                       | 112                                      |
| Railroads                       | $\begin{array}{c} 17 \\ 141 \end{array}$ | $\begin{array}{c} 15 \\ 153 \end{array}$ |
| U. S. Consumption               | 363                                      | $\overline{420}$                         |
| Exports :<br>Canada<br>Overseas | $\frac{16}{15}$                          | $\begin{array}{c} 17 \\ 33 \end{array}$  |
| Grand total                     | 394                                      | 470                                      |

above 1954. The total imported in calendar year 1954 was 129,000,000 barrels.

#### Wages Advance

Wages were advanced \$1.20 per day, effective September 1, 1955, as a result of an agreement signed by the union operators and the United Mine Workers. Vacation pay was increased from \$100 to \$140, with two additional days added to the vacation period. The same agreement provided for an additional increase of 80 cents per day starting April 1, 1956. This was the first wage increase since October 1, 1952. It is significant to note that 1955 represented another year of stability in labor relations—there have been no general wage disputes since the early part of 1950.

Coal suppliers with Government contracts in excess of \$10,000 became subject to a minimum wage applying to miners under provisions of the Walsh-Healey Act as a result of an order by Secretary of Labor Mitchell, effective November 25, 1955. A preliminary injunction was granted limited to two parties who contested the order.

#### **Prices Change**

Bituminous coal mine prices, after seven years of decline were advanced September 1, 1955, the date of the new wage contract. The advances ranged between 25 and 45 cents per ton according to the National Coal Association.

Mine prices began to drop after 1948 and from that year and until the summer of 1955 had decreased from 50 cents to \$1.00 per ton in the more important mining areas. These price reductions took place while there were three general wage increases and substantial advances in other mining costs.

The bituminous industry was able to survive the price-cost complex by making exceptional improvements in productivity as well as by shrinking profits and eventually going into the red. It was clear, however, once the 1954 financial statements had been released that the industry had absorbed about all the losses it could and still remain a going concern. Higher prices were needed to cover the 1955 wage contract. Moreover, it was essential that the industry's earn-

ing position be bolstered so that it could plan with regard to financing future expansion and advancement.

#### Transportation

The reductions in mine prices between 1948 and 1955 were not passed on to consumers in many cases because freight rates were increased five times in the period. Yet, it is found that the mine price reductions approximated the freight rate additions so that the delivered prices on rail shipped coal remained fairly constant. A part of the lowered mine price was effected by shipping an improved product; for example, more heat value per ton.

The Interstate Commerce Commission, in its  $Ex\ Parte\ 175$  decision in October 1955 authorized the railroads to make permanent the 12-percent general freight rate advance on coal that had been granted temporarily in 1952 in connection with these proceedings. In December 1955, the railroads filed for a seven percent increase on coal and other commodities.

Railroad car shortages were in evidence by the early summer of 1955. Certain of the railroads are short in coal carrying capacity and will have to get a considerable amount of additional equipment if they are going to serve their shippers adequately. Activity started in acquiring new cars and pushing repair programs ran into

the difficulties of material shortages that accompany peak business periods. Some of the railroads are planning their coal transportation requirements on a long term basis, which appears essential if the shipping demands of a growing coal industry are to be satisfied.

The coal industry and its buyers have been studying ways to lower the transportation cost of coal in order to be closer to the transportation costs of oil and gas. Progress by the utilities in long distance transmission has tended to locate power generation plants near the coal fields, with electric energy moving in excess of 150 miles relatively cheaper than coal could be shipped by rail the same distance to be converted into electricity. Pittsburgh Consolidation Coal Co. started to lay its coal pipeline in the early fall of 1955, the first commercial venture of this kind. The line, when completed, will stretch 108 miles from the company's Georgetown production facilities in Ohio to the Eastlake, Ohio, station of the Cleveland Electric Illuminating Co. It will transport over 1,000,000 tons of coal an-

#### Mine Capacity

Bituminous mining capacity exceeded production needs in 1955, but its margin of excess was considerably smaller than a few years back. In earlier years, bituminous usually had the men and mines to give large additions to current output if needed. It had an excess capacity under five-day operations of probably 30 percent as late as 1950.

A sizable shrinkage took place in capacity after 1950, and particularly in 1953 and 1954. Over 150,000 workers were separated from the mine payrolls, most of whom eventually got jobs in other industries and are lost to mining. Hundreds of large mines were closed, many permanently. As a result, mine capacity in 1955, de-



More intense mechanization will require more capital than heretofore

spite great strides in productivity, probably had a margin over production of no more than 10 percent.

Shrinkage in coal mine capacity was a principal concern of the Advisory Committee on Energy Supplies and Resources Policy appointed by President Eisenhower on July 30, 1954. Coal was the main supplier of energy in World War II, as in previous emergencies, and there was reason to know that it would be called upon again to mine great tonnages should there be another emergency. This coal would be unable to do unless its declining trend in capacity were reversed. The Energy Committee, in its report released on February 26, 1955, made specific recommendations for the purpose of removing obstacles hindering coal's opportunity of remaining a major supplier in the energy market. It treated problems like the dumping of off-peak natural gas loads and of foreign residual oil, the burden of increasing freight rates, discriminatory restrictions by foreign countries on imports of U. S. coal, and the inconsistent fuel purchasing policy of the Government; all of which had harmed the coal industry and contributed to its decline.

Findings of the Energy Committee are of paramount importance in clearing the way for sound competitive enterprise but the responsibility of mining coal efficiently falls upon the coal industry. In this respect, coal has to plan and find the way for maintaining a mining capacity as required by the expanding economy and for any war emergency. With regard to growth in the next 10 years-probably as much as 100,000,000 tons-coal will need to build 50 new mines, each the size of today's larger operations. Replacements for present operations that will be depleted and abandoned will take another 50 mines of similar size. A huge investment will be required to finance this capacity construction; modern mines may need as

gree of stability in the coal industry. Larger buyers recognize this essential and, as a consequence, are tending to plan and contract for their coal purchases over a long period instead of from month to month, or year to year at the most, the common practice of the past. Coal buyers are getting larger in tonnage needs and fewer in number-presently the 70 largest consumers use half of the commercial coal in the countrywhich means that long term purchasing has a chance for greater development. Contracts covering 5, 10 or more years ahead promote steadier production, economies in mine operations, and a relatively lower price to provide the return required for mine investment.

The industry already has taken the initial steps towards building capacity. In 1955, over 10,000,000 tons of mine capacity annually was planned, as to which construction was started upon a good part. This is a remarkable showing after 1954, one of the worst years in coal's history.

#### Industry Efficiency

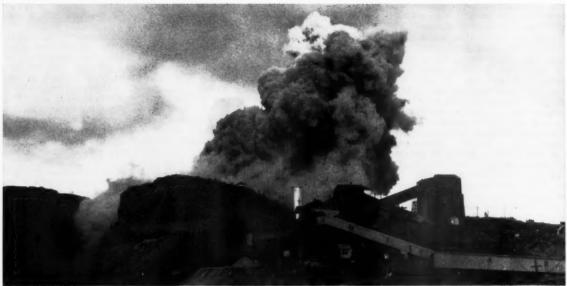
Outstanding among the achievements of the bituminous industry has been its gains in productivity. Output per man-day approximated 10 tons in 1955, an increase of 60 percent since 1948. Coal operators with the cooperation of the mine workers plan for continuing improvements in output.

Fuel energy supplied abundantly at relatively low cost has been a key factor in generating the growth of the American economy, Coal has contributed heavily in this regard by supplying the tonnage required in peace and war, and with steadily increasing efficiency. Future economic expansion will depend upon further advancements in energy production, and as to which it can be expected that coal will make even greater contributions than it has.

More intensive mechanization ahead will mean more expensive equipment. Larger volumes of capital will be required to install the modern machinery that promises to better cost performance. Moreover, the mine itself has to be large so that the equipment can be fully utilized, and it has to have coal acreages that will support production for 25 years or more. Hence, a multi-million dollar investment will be involved in getting the benefits of improved mechanization, all of which will center around the ability of the coal industry to establish an earning position that will attract the capital to be needed. It will be a good investment, however, and one that will pay dividends to the consumer just as previous investments in mechanization have done.



Paced by a 120-percent increase in overseas exports, bituminous coal sales enjoyed a markedly better year



(Photo courtesy Sault Daily Star)

Dust cloud at Helen Mine, Algoma Ore Properties, at time of pillar blast

# Underground Metal Mining Progress

A Year of Record Activity Finds Underground Mines
Keeping Pace With New Techniques and Improved
Equipment

#### By J. MURRAY RIDDELL

Consultant and Professor of Mining Engineering Michigan College of Mining and Technology

THE year 1955, like the ones immediately preceding it, accounted for noteworthy technological progress and plant facility achievement. In taking inventory, one cannot refrain from noting the ever-increasing importance of the skilled worker as pertinent to the proper operation and maintenance of the machine.

During the period four new operations of magnitude started production: (1) The San Manuel Copper Mine at San Manuel, Arizona, which, for the time being at least, was destined to be the world's greatest daily tonnage producer; (2) The White Pine Copper Mine, White Pine, Michigan; (3) The Peterson Iron Ore Mine, Bessemer, Michigan; and (4) The Cannon Iron Ore Mine, Stambaugh, Michigan. These plants embraced commendable refinement of design

and completeness of facility, coupled with efficiency and economy of operation.

Beyond mechanization lies automation. It was no longer confined to factories and similar industrial plants. Automatic skip hoist operations coupled with skip loading and dumping was achieved. While automatic pumping operations were already known, that practice expanded appreciably.

Record-wise, four time-period accomplishments were recorded: (1) tunneling, (2) vertical shaft sinking, (3) the blasting of an underground supporting pillar, and (4) the reclaiming of a mine by unwatering.

#### Development

It was interesting to note that in contrast to the general trend of mechanization, all development records



Most of the industrial life of J. MUR-RAY RIDDELL has been spent in the Lake Superior district in connection with the production of iron ore. For the past 10 years he has been chairman of the Department of Mining Engineering at the Michigan College of Mining & Technology. From now on he will retain his rank of Professor of Mining Engineering and will divide his time equally between the College and his consultant practice. He is the inventor and licensor of the vertical shaft mucking apparatus which bears his name.

were set by using conventional equipment or manual labor.

In Scotland, 557 ft of tunnel were driven in seven days; the drilling was done with air leg-mounted drills and mucking accomplished with an Eimco 21 loader. In South Africa 1394 ft of drift were completed in 26 days; again, air leg-mounted machines were used; mucking was done with a model 40 Eimco loader. The fact that temperatures over 100°F existed in the latter heading makes this record even more admirable.

At the Monarch Shaft of the West Rand Consolidated Mines Ltd., South

Africa, a vertical shaft sinking record was established during September, an advance of 763 ft in 30 days. The shaft was of rectangular configuration and timber lined; size, outside of sets, 12 ft by 20 ft. It was hand mucked. This commendable accomplishment exceeds the previous South African record of 667 ft of circular concrete-lined shaft completed in a calendar month and thus establishes a new world record for all types of shafts. Pertinent to the work of the labor force of the shaft, exclusive of top supervision, a six-hr shift was adhered to; the number of manshifts consumed per day beneath the collar totaled 185. The surface labor numbered 104 per day; which makes a grand total of 289.

#### **Hoisting and Appurtenances**

Considerable interest has been shown and many articles have been written on friction drum multi-rope hoists and regular drum single rope hoists. New installations of each type are in operation in North America. At the Cleveland Cliffs Iron Company's "C" shaft Cliff-Shaft Mine two Koepe multi-rope hoists are now operating on a regular production basis. They are mounted in the headframe structure and near the top. This arrangement marks a new departure from past practices in America, although like facility has been carried on in Europe, especially in Sweden, for several years. As the year closed, five Koepe units were being installed in Canada, two in the United States.

At the Columbia Southern Chemical Company's mine at Barberton, Ohio, a completely automatic skip loading arrangement was placed in service on a production basis. It functions in connection with an automatic hoist, and is tied to it electrically. The loading system consists of two 10-ton capacity measuring bins hav-

ing two gates each, an upper guillotine gate through which the bin is loaded from the main storage bin, and a lower arc gate through which the ore passes to chutes into the proper skip. The gates are operated hydraulically. The various operations of the loading cycle are actuated and controlled by limit switches which operate timer switches and relays in a control panel to insure proper sequence. The system is designed so that it will stop when ore is not available and restart itself when ore comes into the main storage bin. It is also designed to shut off in case any of the points in the cycle fail to function properly. Installed principally to eliminate delays caused by human failure that resulted from manual operation, it has done much to provide a continuous flow of ore to the plant.

Bottom dump skips gained in popularity. This was attributable to faster dumping time as contrasted with the Kimberly-type skip, faster signal response, and the ability to establish optimum performance for all but the loading cycle. Generally speaking, experience has shown that hoisting capacities have been increased 10 to 15 per cent by their use, other things being equal.

Wire rope manufacturers recently introduced a new wire rope having an increased strength capacity of 15 per cent.

At the mines of the International Nickel Co. near Sudbury, Ontario, two large ore-hoisting installations were completed. They were a part of a conversion program and marked the completion of a four-unit job. All hoists were designed for a rope pull of 90,000 lb, capable of handling a 15-ton load at a maximum speed of 3000 fpm from a depth of 4300 ft. Each unit is driven by two 3000-h.p. d.c. motors with rotating amplified control. All are cylindrical double



Roof bolting in a Sudbury, Ont., nickel mine

drum geared units, two with drums mounted in line and two with drums in tandem. Other features embraced semi-automatic hoisting with pushbotton control at the underground loading pockets and bottom dump skips.

#### Pillar Blasting

On September 24, there was deto-nated at the Helen Mine of the Algoma Ore Properties, Jamestown, Ontario, 153 tons of dynamite which fragmented an ore pillar containing 1,200,000 tons. Eighteen months of time were consumed in drilling and loading 2484 holes. This controlled millisecond operation consisted of 12 separate explosions, all of which took place within a half second; it was designed to give maximum fragmentation of the ore and a clean break. There was no damage done to the surface structures. So far as is known, this single underground blast marks a record achievement.

#### **Ground Support**

The use of rock bolting gained in favor during the year. In the metal mines of the U. S. and Canada the number of bolts used each month probably exceeded 500,000. Their diversification in use was enhanced also.

Numerous operators used rock bolts in stopes, permitting the use of the cut-and-fill method to greater depths than usual. Under certain conditions, this scheme has replaced normal square set timbering.

Research on rock bolting equipment and methods was continued by both mine organizations and government agencies.

Rock bolting in conjunction with gunite and coarse mesh wire screen, individually and collectively, gained in popularity. Numerous operators are of the conviction that this arrangement accords excellent protection.

The yielding steel arch, originally a European development, was used to a limited extent in United States



Surface plant at the Cannon Mine. M. A. Hanna Co.

and Canadian metal mines. Under certain conditions it has served well a purpose. Up to a certain point, the arch offers firm resistance to pressure; under excessive pressure it will yield slightly before deformation of the supporting components.

The chemical treatment of mine timber expanded during the year. Noteworthy was a new vacuum treatment plant installed at the mines of the Falconbridge Nickel Mines Limited, Falconbridge, Ontario, and the operation is known as the Dri-Vac process. Versatility was one of the important aspects of the plant, since any one of three different chemical mixtures could be used, and wherein the change-over period was of short duration.

#### The Osceola Project

The year 1955 marked the initial completion of the unwatering of the Osceola Lode workings of Calumet Division of Calumet & Hecla, Inc. at Calumet, Michigan, and the resump-tion of production from the first of two producting shafts. The objective of the undertaking was to make available a substantial reserve which was abandoned and allowed to flood in the '30's, and at the same time to replace other mines facing exhaustion. In that the Osceola and Conglomerate workings were interconnected, it was also necessary to remove all of the water from the upper portion of the Conglomerate workings as the Osceola Lode was unwatered.

This unwatering started in March 1953. Over six billion gallons of water have been pumped. Before the second production shaft is rehabilitated an additional billion gallons will be added.

Sampling before the unwatering commenced indicated three important facts about the water to be removed. It was found to be corrosive, containing a high percentage of methane, and stratified as to specific gravity with a layer of relatively normal water on top.

The water has been lowered from an elevation slightly below surface to a vertical depth of 2100 ft. All of the pumping equipment was manufactured by the Byron Jackson Division, Borg Warner Corp. It included vertical and inclined submersible types, some of which were of special design, and conventional centrifugal pumps. In total, 19 pumps were used with a total connected horsepower of 8600. The maximum quantity of water delivered at any one time was 15,000 gpm. Throughout, the job has been well planned and executed.

#### Stockpiling of Ore

At the iron ore mines of Lake Superior it is necessary to stockpile production during the December-April period because of the closing of lake transportation. In the past, such stockpiling has been performed by cars or belt conveyors mounted on a trestle work, or by means of dump trucks which build the pile as part of a progressive operation. The past year witnessed the completion of a new approach to the problem, that of making use of an aerial tramway.

In designing the surface facilities for the new Peterson Mine of the Puritan Mining Co., Bessemer, Michigan (jointly owned by Bethlehem Steel Corp., and Youngstown Sheet and Tube Co.) the engineers of Pickands Mather and Co. (operating agents) investigated all past practices, including the aerial tram as applied to waste disposal at coal mines.

The tram is a two-carrier reversible jig-back aerial tramway with two 170 cu ft cars capable of traveling 1500 fpm. Each of the two cars (see cut) are suspended from an independent cable span consisting of four 2-in. lock-coil cables extending 1500 ft from the loading terminal structure at a height of 85 ft to the top of a tail tower 165 ft high. The two tail towers are set 125 ft apart. At the loading terminal the cars are loaded through undercut gates which open and close by the movement of the car as it enters and leaves the terminal. The 12-ton load is automatically discharged as desired at any point along the 1500-ft span. Provision has been made for the stocking of 970,000 tons of ore; stockpile height is 70 ft.

The car is a "V" bottom automatic dump car discharging on the trailing end. A built-in automatic and adjustable device driven by the car wheels trips the door. The dumping point is quickly changed by a set screw adjustment on the car when it is in the loading terminal.

#### White Pine Copper

Currently the operations of The White Pine Copper Co., in Northern Michigan produced at about the rate of 14,000 tons of ore per day with a total hourly labor force of 450 people. Equipment-wise, nothing is revolutionarily new that has not previously been published. Detailed studies were made of mine conveyor belt installations as a supplement to, or replacement of, underground truck haulage. Experimental work on breast drilling continued in an effort to improve the drilling program.

#### **Aerial Towers**

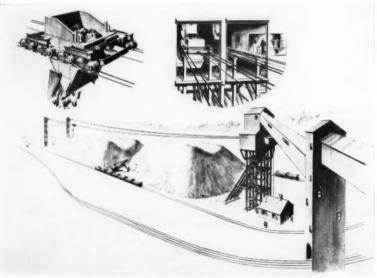
For scaling, or high work, in open stopes where three dimensional movement was essential, a unit was produced by Mobile Aerial Towers, Inc., Fort Wayne, Indiana, which had appreciable merit. It was truck-mounted, powered by the truck's engine, and provided quick accurate movement by the operator on the platform. The booms were hydraulically actuated, and mounted on a standard truck.

#### Pumping

For pumping against heads of 1200 ft or less, there appears to be a marked trend away from plunger pumps and toward vertical turbine and horizontal centrifugal pumps, which are equipped with fully automatic controls.

#### **Stope Filling**

To eliminate the driving of high and costly stope filling raises or transfer drifts, a new type of auger drill was employed in the Michigan mines of the M. A. Hanna Co. The Ka Mo auger drill was successfully used to drill nine-in. holes, subsequently



Aerial tramway at the Peterson mine, Bessemer, Mich.



View of 30-in. diameter water discharge at the Osceola unwatering project

reamed to 18 in., up to 120 ft in depth. Horizontal holes and near vertical holes were drilled with success in ground of medium hardness. Rotating power for the auger was furnished by a 50-hp electric motor, and a five-hp air motor supplied power for the feed. Steel changes were four ft in length.

The use of classified sand tailings for stope filling was expanded.

Churn drill holes are now being used for passing concrete from surface to underground workings without going down the shaft.

At Falconbridge, two new practices proved to be successful. Diamond drill holes were used to convey tailings fill from surface to the various levels underground. Capital and maintenance costs were lower than

with a pipe system.

Polyethylene film, (.002 to .004 in. thick) was used to waterproof tailing fill retaining barriers. This was made necessary to prevent the drain water from running into adjacent sand filled areas, or down certain travelways.

#### **Drill Machines**

For normal production operation in stopes and faces, requiring small holes of limited length, airlegs generally gained in popularity and at the expense of stopers and conventional levners.

Drill manufacturers, in close cooperation with the mining companies, materially improved the design and operation of the airleg type of machine featuring a larger piston bore, feed leg control on the handle of the drill, leg joined to the drill through a hinged connection mounted on a boss beneath the machine, and air fed to the leg through ports in the drill and the hinged connection.

Newly developed equipment for deep-hole percussion drilling was offered by Gardner Denver Co., Model SFH-123, 41/2-in. bore.

Ingersoll-Rand's Hydra-Boom, which was designed to accomodate a series of drifters with various feed arrangements, has shown itself to be a very versatile and dependable hydraulically-operated drill boom.

In the softer rocks, very favorable reports have been received about the use of high-pressure-feed rotary drills in the headings. Joy Manufacturing Co. carried on appreciable experimental work in this direction. The machine was electrically driven.

#### **Drill Bits and Steel**

There remained a vast amount of commendable independent thinking in this instance, and it is difficult to establish distinctive trends. On the whole, it would appear that there was a slight tendency of changing over from integral tungsten carbide tipped drill steel to detachable tungsten carbide bits. Nevertheless, it must be recognized that the integral type remained extremely popular with many users.

The problem of connection between the detachable bit and the drill steel received considerable attention. Tapered connections in certain instances warranted a change-over from screw connections. Other test work with tapered connections did not prove satisfactory. From available data it is difficult to sense a trend of significance.

Inco's comment on tests and investigations on chisel-type carbide insert steel was of significance: "Sharpening was found to be the key to better re-Premature sharpening and sults. over-sharpening were proven to affect steel performance to a very much greater extent than had ever been considered previously.

"Carefully controlled drilling tests. in which insert dullness, or width of flat, was measured to an accuracy of 0.1 mm, showed that one-quarter of the footage per sharpening is obtained when the insert has reached the half-

dull point and the remaining threequarters from the half to fully dull point.

"This is because only one-quarter of the volume of carbide drilled away lies above the half-dull point, as compared to three-quarters from there to full dullness. It is therefore obvious that premature sharpening wastes valuable footage by grinding away the insert as it approaches its most economical drilling condition. Theoretically, the life of a steel sharpened each time at the half-dull point would be only 50 percent of that which could be expected if the insert were fully dulled before each sharpening.

"By the same reasoning, it is obvious that fully sharpening a dulled steel is an uneconomical practice. Here again it can be proven theoretically that the footage of a steel fully dulled and fully sharpened each time would be increased by 50 percent if the steel were only halfsharpened consistently."

#### Miscellaneous

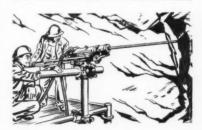
There was a marked step-up in the training of employees at the foreman's level. Management, more than before, recognized that the foreman's responsibilities were being increased by the socialogical trends of the time.

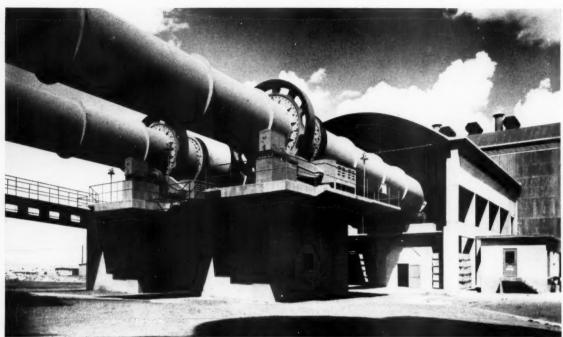
Over the years there has been a progressive tendency to think in terms of bigger and better units of equipment. The uranium operations of the Plateau called for small sized earthmoving equipment, and manufacturers were quick to sense the need. Resultingly, some of the small units advantageously found their way into large scale operations.

During the year two prominent mine names were taken from the underground category and placed on the open-cut side, notably the Inspiration Mine of Inspiration Consolidated Copper Co. and Kennecott's mine at Ray. Ariz.

#### Acknowledgments

This compilation is the result of observations in the field, a review of current technical literature, and the exchange of an appreciable amount of correspondence. To my many friends and associates who have so graciously given of their time I am indeed indebted and ever grateful.





Important in the expansion program of cement plants are the huge rotary kilns used for burning the raw materials

# Portland Cement in 1955

Cement Industry Leads Construction Material Field in Capacity Increase and Sets Ninth Consecutive Annual Production Record

By H. A. SAWYER

President Lone Star Cement Corp.

THE portland cement industry in 1955 set a new all-time production record for the ninth consecutive year, a record probably unparalleled in American industry. Each year since 1947, the cement industry has established a new all-time production mark, topped off the past year by a figure which it is estimated will pass 300 million barrels.

Although final figures for 1955 are not yet available, Bureau of Mines figures for the first nine months of the year, through September, show production up 11 percent over the same period for 1954. At this rate, a production of 301 million barrels is estimated for 1955. The industry definitely passed the 300 million mark in 1955, and 1956 will go considerably beyond that figure.

A 300-million barrel total represents an increase of nearly 200 mil-

lion barrels or a tripling of cement output since the end of World War II, when the current unprecedented demand for cement really began. It also represents a 67.3 percent increase over the largest prewar year, 1928, when 176,298,846 barrels were produced.

The tremendous growth and expansion of the portland cement industry is emphasized by the important milestones reached within the industry in the past decade. It was in 1920 that the industry first produced 100 million barrels of cement—100,023,045 to be exact. Production was up to 176 million barrels, a pre-World War II peak, in 1928. But then came the depression years of the thirties, and not until the second World War came along did production again approach that figure. The industry topped 200 million barrels—producing 203,007,885

barrels—in 1948, the second straight year for an all-time high. Each year since, another new all-time production record has been set.

#### Capacity

With production increases in the industry also have come industry expansion and increase in capacity, increases that give the cement industry the lead in capacity increase in the construction material field.

In October 1954, the Bureau of Mines made a survey of future cement-producing capacity for President Eisenhower's Advisory Committee on a National Highway Program, commonly known as the Clay Committee because of its chairman, General

| CEMENT PRODUCTION   |   |  |  |  |    |  |  |  |   |                   |   |  |  |
|---------------------|---|--|--|--|----|--|--|--|---|-------------------|---|--|--|
| Year                |   |  |  |  |    |  |  |  | 1 | Plants            | Production in Bbl   |  |  |
| 1920                |   |  |  |  |    |  |  |  |   | 117               | 100,023,245   |  |  |
| 1928                |   |  |  |  |    |  |  |  |   | 156               | 176,298,846   |  |  |
| 1947                |   |  |  |  |    |  |  |  |   | 150               | 186,519,347   |  |  |
| $\frac{1948}{1949}$ |   |  |  |  |    |  |  |  |   | $\frac{150}{150}$ | $\begin{array}{c} 205,\!448,\!263 \\ 209,\!727,\!417 \end{array}$ |  |  |
| 1950                |   |  |  |  |    |  |  |  |   | 150               | 226,025,849   |  |  |
| $\frac{1951}{1952}$ |   |  |  |  |    |  |  |  |   | $\frac{155}{157}$ | $\begin{array}{c} 246,022,476 \\ 249,256,154 \end{array}$         |  |  |
| $\frac{1953}{1954}$ |   |  |  |  |    |  |  |  |   | $\frac{157}{157}$ | $264,023,000 \\ 271,273,398$                                      |  |  |
| 1955                | 1 |  |  |  | t. |  |  |  |   | 157               | 301,000,000   |  |  |

Lucius D. Clay. Producers in the continental United States were asked to estimate their capacity as of the end of 1954 and 1956 based on then-current expansion plans, and as of the end of 1959, "assuming that the proposed fifty-billion dollar, 10-year highway program is enacted by Congress in 1955, and assuming that new construction and maintenance and repair, other than highway construction resulting from the 50-billion dollar highway program, will remain at about the current level..."

From the canvass the following national totals were compiled:

For 1954—290,753,000 bbl 1956—338,584,000 bbl 1959—407,237,000 bbl

As of December 31, 1953, estimated capacity of the cement industry in the continental United States was 287.498.470 bbl.

The industry expanded its capacity approximately 11 million barrels in 1954, and trade journals covering the cement and concrete fields show some 50 companies with new plant or plant expansion plans in 1955 and 1956. This expansion is expected to result in an increase of 59 million bbl of additional capacity. These figures come only from those companies which have announced expansion plans publicly. Many smaller companies have no publicity or public relations departments and their plans frequently go unreported. It is very likely that the actual total is even greater.

Thus, announced increases in capacity to be completed by the end of 1956 are already in excess of the figure given in 1954 by the Bureau of Mines. To date, no one has suggested that the year-old Bureau of Mines forecast of 338 million capacity at the end of 1956 would not be adequate, so it appears that the industry can surely meet expected higher requirements in the years immediately ahead.

A more recent survey conducted by Joseph S. Young, president of Lehigh Portland Cement Co., the results of which were presented by him before the Financial Analysts in Philadelphia on November 3, 1955, contained a slightly different approach to the question. Mr. Young's survey was based on total prospective portland cement clinker capacity as of December 31, 1956. In clinker form, the material is only one stage from finished portland cement. The clinker must be ground and a small amount of gypsum (about 5 percent by volume) is added in this process. On this basis, it was reported that total capacity of the industry by the end of 1956 would be more than 368 million

The current rate of expansion as indicated by surveys and by announced industry expansion plans point toward a fourth new mark in the next decade: that of 400 million bbl annually. This would mean a 300 percent increase in production, or a quadrupling in cement production since the end of World War II, when the figure stood at 101 million bbl.

This rate of expansion is unmatched by any other industry in the construction material field, and is among the most impressive in all industry. Cement manufacturers will spend 66 percent more money for expansion and improvement in the coming year than in 1955, according to a recent McGraw-Hill industry survey. This compared with 24 percent more for the canning industry, 23 percent for rayon chemicals, and 18 percent for fabric mills, those industries showing the next largest increase in spending plans.

#### **Problems in Meeting Demand**

Although the industry is expanding at a record rate to meet the unprecedented demand for its product, many



Final sections of the 241-mile Ohio Turnpike were open to the public in 1955

of the problems involved in meeting current demand are the same as those encountered in previous years. The location of new plants and the expansion of existing plants is still determined largely by the location of available raw materials and by urban markets.

Population shifts and unusually heavy construction in previously undeveloped areas have caused some distribution problems. Because cement is heavy, it is important that cement mills be located as close to large urban areas as the availability of materials permits. The relatively mild winter of 1954-55 permitted more wintertime construction, depleting stocks and in some areas causing temporary delays.

#### Uses of Cement

More portland cement was used in the construction of highways and nonTrained in civil engineering, H. A. SAWYER has had experience in engineering, sales, and operations. He joined the Lone Star Cement Corp. in 1925 as a service engineer and a year



later was made assistant sales manager. In 1931 Mr. Sawyer was made vice-president and manager of the Louisiana Division of his company and in 1952 was made president. He is also a director and member of the Executive Committee of Lone Star Cement Corp., director of Compania Argentina de Cemento Portland, president and director of La Compania Cubana de Cemento Portland, and director of the Portland Cement Association.

residential building in the past year than for any other use, according to estimates compiled by banking, investment and trade magazine sources. They show that about 20 percent of the entire output was used for each of these categories in the past year, with residential building using 15 percent, military and naval construction 10 percent, public utilities 10 percent, sewer and water works 8 percent, and other construction including conservation, farm, maintenance and repair 17 percent.

Highways. Although it is too early as this is written to determine the success or content of any additional Federal highway legislation this year. nevertheless all signs point to another record year of road-building. The Departments of Commerce and Labor have forecast a 12 percent jump in road-building this year, with a prediction of \$4.6 billion for new road construction, compared with \$4.1 billion spent in 1955. With right-of-way added, this total would reach \$5.3 billion, and with maintenance, debt service and administration costs, the nation's spending for roads is expected to hit \$8 billion in 1956.

The stepped-up work on the nation's highway system is found all along the line, from cities and villages to counties, states and the nation. Almost every major city in the nation is undertaking an expressway or freeway program.

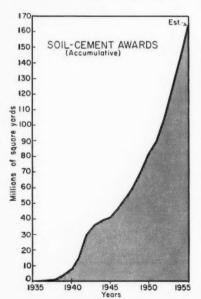
Particular interest in road and street programs, both in cities and states, is being given to heavilytraveled, defense-important thoroughfares. This means heavy-duty pavement, and past records have shown that this means more concrete, which in turn means more cement. Current figures show that 73 percent of the nation's freeways, urban and rural, are concrete, with 67.5 percent of toll roads concrete.

The nation's toll road network gained considerably in 1955 with more than 300 miles opened for traffic and some 1363 miles under construction. Biggest link opened to traffic was the 241-mile Ohio Turnpike, all-concrete, linking the Pennsylvania Turnpike on the east and the Indiana Turnpike, under construction, on the west. Some 1697 miles of turnpikes are now in service.

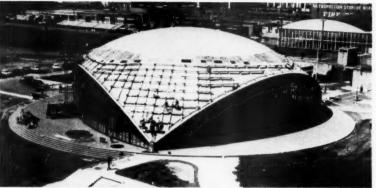
Toll roads contribute favorably to the government prediction of a 12 percent increase in roadbuilding in 1956, with construction on 1627 miles of turnpikes planned to start this year.

Soil-Cement. The year 1955 saw the 20th anniversary of soil-cement paving, a field which now takes approximately two million bbl of cement annually. In the 20 years since its beginning, more than 10,000 miles of roads, streets and airfields have been paved with soil-cement, and, according to contracts awarded for 20 million sq yd last year, 1955 was estimated to be another record year for soil-cement.

Appropriate ceremonies in October 1955, marked the 20th anniversary of the first fully-engineered soil-cement road—a 1½-mile stretch of State Highways 41 and 51 near Johnsonville, South Carolina. Participating



Graph showing the tremendous growth of soil-cement in the 20-year period since it was developed



Concrete shell construction has made possible such revolutionary design as that used for the auditorium at M.I.T.

in ceremonies at the scene were representatives of the South Carolina State Highway Department, U. S. Bureau of Public Roads and the Portland Cement Association, joint sponsors of this first road in 1935.

Tests of samples cut from this pioneer road showed that the road had doubled in strength over the 20-year period. Such durability, plus economical cost factors, make this tightly-compacted mixture of soil, water and portland cement popular for all types of paving construction, thus creating stepped-up demand for cement in this area.

Work in research and development continues to bring new and increased uses for cement and concrete. Along with an increased use of concrete per unit of construction, such relatively new concrete construction methods as thin-shell and prestressed are becoming more widely accepted and are increasing concrete usage.

#### Thin-Shell

Thin-shell roofs are finding increasing favor for gymnasiums, aircraft hangars, and commercial and industrial buildings because of the large unobstructed area. The thin, curved concrete slabs have great load-carrying capacity which makes possible the elimination of large supporting columns or large ceiling beams. A number of outstanding examples of thinshell roof construction were completed in the past year, among them being a striking auditorium at Massachusetts Institute of Technology and such impressive school buildings as that of the Edsel Ford School in Dearborn, Mich., which has three separate thinshell roofs covering its recreational

#### Prestressed Concrete

Prestressed concrete, which has really come into its own in this country in the past five years, continued to gain favor in 1955 with approximately 40,000 lineal ft of prestressed bridges either constructed or begun

during the year. This record figure almost doubles the 21,000-ft total for 1954. A number of outstanding projects were reported during the year. including New Orleans where work was begun on the world's longest highway bridge, a 24-mile bridge across Lake Pontchartrain. The roadway is being laid with prestressed and precast concrete slabs 56 ft long and 33 ft wide. Each slab is prestressed with 175 separate strands of prestressing steel. In East Peoria, Ill., six prestressed girders 109 ft long, second longest prestressed girders used in building construction in the United States, were built in place for a gymnasium-auditorium addition to a high school.

The increasing number of plants producing prestressed and precast concrete structural units indicates a wider range of use for cement in the construction field.

Other factors are contributing, and will contribute in the coming years, to increased use of cement. These include the post-war boom in housing and school construction, with badly needed schoolroom space a major national problem, and the increased use of concrete for airfield paving, particularly military, because of concrete's performance under modern jet plane operations.

#### The Outlook

Another record-breaking year in construction spending is forecast for 1956 by the U. S. Department of Commerce and Labor. These agencies predict a new construction volume of \$44 billion, representing a 5 percent increase over 1955.

The Commerce-Labor statisticians base their 1956 estimate on the assumption that there will be a moderate increase in overall economic activity. The estimate also reflects the tremendous volume of construction in progress in 1955, much of which is carried over into the new year.

The types of construction predicted to show reasonably large increases include public housing, commercial



Paving trains like this indicate that more and more concrete is being used in the nation's highways



Workmen post-tension a 109-ft prestressed girder used in the construction of the gymnasium of a new high school

building of all types, churches, social and recreational facilities, public utilities, military, sewer and water facilities, highways, and public services including airport construction. Since portland cement is the most widely used of engineering construction materials, it cuts across all these construction categories. Construction activity in the months ahead is expected to include more work of the types which consume proportionately more cement, such as many grade separations for urban highway improvements and waterworks and sewage facilities for urban areas.

Thus it is readily indicated that

domestic markets for portland cement will use more than 300 million bbl in 1956.

Production of ready-mixed concrete, concrete pipe and other products is expected to set new records again in 1956. One magazine survey forecasts that the production of commercial ready-mixed concrete will pass the 92 million cu yd mark in 1956. The same survey estimates a record volume of 2¼ billion standard equivalent units (8x8x16-in. block) in 1956 to meet the needs of housing, commercial, industrial building, and other consumers of precast products. This would be an increase of six percent

over 1955. Again, the survey estimated that concrete pipe production would approach 13 million tons this year.

Such increased figures as these, which may be found all along the line in the industry, plus unparalleled expansion under way in cement plants themselves, leave little question but that cement manufacturers and producers of concrete products are making all-out efforts to match record strides in construction. In fact, when one considers the mammoth cost of expansion under way within the industry, it is clear that the portland cement industry has placed all faith in the strength of the future construction market and in the strength of our economy.

#### **New Safety Records Set**

For the second straight year, the portland cement industry set all-time safety records in 1954. A total of 152 operating units, including plants and quarries, participated in safety programs coordinated by the Portland Cement Association's Accident Prevention Bureau.

The industry set all-time low frequency and severity rates of 3.38 disabling injuries per million man-hours worked and .92 days lost and charged per thousand man-hours worked, respectively.

The industry also established the most favorable output-injury ratio in the 39-year history of its accident prevention activities. The record ration of more than one million bbl of portland cement produced per disabling injury in 1954 was 47 percent more than the 1952 figure and 15 percent above 1953. Reported mishaps in 1954 were 12 percent fewer than in 1952, and 26 percent fewer than in 1953.

Preliminary figures for 1955 show an increase in severity rates but a 15 to 20 percent reduction in frequency rates for the past year.

Despite the hazards of quarrying and mining, use of extreme heat and massive amounts of electricity, the portland cement industry is rated the safest of all heavy industries.





Mine shutdowns have brought supply into closer line with demand but have crimped needed productive capacity

# Anthracite in 1955

Production Plunge Slowed Down as Part of Industry
Looks to Diversification into Related and Unrelated
Lines

By EDWARD G. FOX

President Reading Anthracite Co.

ALTHOUGH there were definite signs that the sales curve for anthracite had flattened off, 1955 on the whole was another unfavorable period for the industry. Price realizations remained depressed even though there was evidence at the end of the year, when demand became heavy, that they were stiffening. Financial losses were substantial.

Commercial production of the entire industry was down about 4½ percent from 1954, from 26,100,000 tons to an estimated 24,900,000 tons in 1955. On the other hand, total industry sales for the 12-month period ending October 31, 1955 was 25,900,000 tons, which was approximately the same amount as sold in the previous period. However, sales of union-produced anthracite dropped from 23,-

500,000 tons in the 1953-54 period to 22,800,000 tons in the 1954-55 period, nearly three percent, while sales from non-union sources increased almost 15 percent to 2,400,000 tons in the 1954-55 period from 2,100,000 tons in the previous period. Sales from producers' inventories went up from about 300,000 tons in the 1953-54 period to approximately 700,000 in the 1954-55 period.

Non-union tonnage was prepared at more than 100 small breakers in the Anthracite Region. A great portion of it was of sub-standard grade. It was a major contributor to the depressed prices that prevailed throughout the anthracite market during the year. Non-payment to the U.M.W.A. of the health and welfare assessment, a longer work day and

failure to comply with safety regulations were important factors that permitted the sale of this tonnage at very low prices. Another group that added considerably to keeping prices depressed was a number of so-called union producers who did not comply with their contractual obligations to the U.M.W.A. by non-payment of the health and welfare assessment.

#### Prices Off

Many dealers and consumers continued to ignore the numerous bona fide inducements of the majority of producers to purchase during the late spring and summer months. The majority of those that were interested in buying during these seasons were only interested when the prices offered were extremely low. Some producers practiced this approach since they believed that the only course open to them in a declining market was to reduce their prices sharply in an effort to get more of the existing business. Other producers, of course, were desirous of protecting their customers from the inroads of competing producers and met the lower prices. The net result was the continued vicious downward spiral of prices that held over into the fall and winter seasons even though demand for some sizes was exceptionally strong during these

A life time in the anthracite coal mining industry particularly qualifies EDWARD G. FOX to write this review article. His early work was engineering, followed by 10 years of various supervisory capacities in operations. In 1937 he was named general manager of Colonial Collieries Co., a position he held until March 1943 when he became general superintendent of the Phoenix Contract-



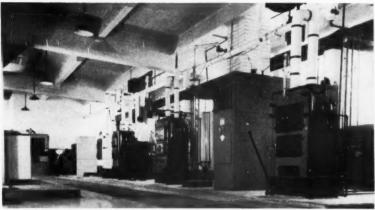
ing Co. Later he was made president of that company. When the Philadelphia & Reading Coal & Iron Co. created. as a subsidiary, the Shen-Penn Production Co. in 1946, Mr. Fox left Phoenix to assume the presidency of Shen - Penn. In 1947 he was named general manager of P & R and was named executive vice-president of the company in 1951. He was elected president later in 1951 and when that company diversified late in 1955, he was named president of the Reading Anthracite Co., a subsidiary.

periods. Nevertheless, there were indications at the end of the year that some individual producers were eager to get higher prices.

#### **Many Mines Closed**

A large number of producing units, particularly the higher cost operations, were closed down during the Many of them were permanently abandoned. Although the past advantage of stepping into sudden large quantity production when necessary was greatly reduced by the shutdowns, the over-all effect generally was considered good in that it tended to bring supply more in line with market requirements for the long steady pull. However, it did create a problem in the last few months of the year when heavy deferred buying occurred on the part of the dealers and consumers as a result of their reluctance to take advantage of the purchase of ample supplies during the late spring and summer months when large quantities were available. Many producers, even though they were working five and six days a week, were far behind in supplying their orders in nearly all the sizes at the end of the year, the peak of the burning season. Stove and nut sizes in particular were in short supply. Inventories at the end of the year, with the exception of pea and buckwheat No. 1 sizes, were limited. The overall supply situation was aggravated considerably by the acute shortage of railroad cars for both shipment of raw coal from mines to breakers and clean coal to market.

The heavy rains that accompanied Hurricane Diane in August created major problems at many collieries. Some were forced to shut down temporarily for pumping and digging out purposes. One large operation filled up to such an extent that it was concluded that permanent abandonment was the best step. Industry-wide



Research to expand end uses of anthracite showed promising results

damages and loss of revenues were great.

A Division has been established for the first time in the U. S. Bureau of Mines to deal exclusively with problems of the Anthracite Industry. It undoubtedly will play an important role in the solution of the many technical problems facing the industry.

#### **Drainage Program Launched**

The joint Federal-State \$17,000,000 mine drainage program was launched during the year. This program provides for the installation of pumps in abandoned collieries at strategic locations and the construction and/or repair of various flumes, ditches and creeks throughout the anthracite area.

The Anthracite Industry again was plagued with competition from foreign residual oil and bulk industrial sales of natural gas at dump prices. It has been continuing vigorously its fight against these evils at all levels.

A strong public relations program to promote the use and sale of anthracite has been in effect for three years. It is supported by all segments of the industry. Many beneficial effects have been produced.

#### Use of Fines Increased

There was a sizable increase in the use of fine anthracite in 1955. The two major markets contributing to the increase were the use of anthracite fines as a blend in the manufacture of coke and in the preparation of taconite iron ores for the blast furnaces of the steel industry. There is every reason to believe that these uses over the years ahead will grow substantially. Considerable research work was performed during the year on the use of large sizes of anthracite, the traditional profit sizes, in blast furnaces and cupolas. The results are most promising. Anthracite gasification for conversion into chemicals was high on the list of the research programs of many of the major producers.

A number of companies have been and are giving a great deal of consideration to diversification in both related and unrelated lines. Some already have taken major steps in this direction. Others undoubtedly will follow. Large financial losses over the past few years in the industry as a result of the severe shrinkage in the market for anthracite was an important factor in bringing about consideration of possibilities of diversification.

#### '56 Looks Brighter

Most producers enter 1956 with genuine hopes of a better year. They have pared their operations and costs to meet the reduced market requirements. The sharp decline of recent years shows definite signs of leveling off. It appeared that prices were firming and demand would continue strong. Freezing weather throughout anthracite's marketing area at the end of 1955 and the beginning of the new year also was very much in its favor.



A joint Federal-State mine drainage program was launched, part of which will provide for the pumping of abandoned collieries



New discoveries were made to augment the production of older Mesabi Range operations

# Review and Outlook for the Iron Ore Industry was much concern Governmental circle availability of iron availabili

Iron Ore Economy Surges to Near-Record; Future
Holds Great Challenge

By A. L. FAIRLEY, JR.
Vice-President and General Manager
Snyder Mining Co.

THE year 1955 was filled with pleasant surprises for the Iron and Steel Industry. During the early part of the year business was beginning to pick up and prospects were encouraging. Coming after the sharply curtailed operations of 1954, even a moderate year would have been good news. But no one foresaw the terrific upsurge in business generally, and in the demand for iron and steel in particular, which developed in the last six months. This burgeoning demand, after a comparatively mediocre start, placed a real strain on the production and transportation facilities of the iron ore industry. Final figures are not yet available, but it appears that the domestic mines produced during the year approximately 106,000,000 gross tons of ore, 80 percent of which came from the Lake Superior District, and an unprecedented 22,000,000 tons

that were imported, for a total of 128,000,000 tons. This is not a record year, since the figure for 1953 is about 1,000,000 tons higher, but it is very close to a record.

#### **Ore-Price Advanced**

The price situation in the industry remained stable and firm during the year. In February the price of 51.50 percent Fe Mesabi Non-Bessemer ore advanced 20 cents to establish a price of \$10.10 per gross ton delivered to rail of vessel at Lake Erie ports. This is the traditional method of pricing Lake Superior iron ore and all ore produced or consumed in Eastern and Central United States is, of commercial necessity, after taking cognizance of variations in grade and transportation costs, roughly competitive with this base price.

Shortly after World War II there

was much concern in industry and Governmental circles over the future availability of iron ore for the continuously expanding needs of the American iron and steel industry. Sixty years and two world wars had reduced the direct shipping ores of the great Mesabi Range to a point where they could no longer be counted on to meet all of these expanding needs. As a result of this situation, a world-wide exploration program was started, which, as we all now know, paid off in a number of large new mining areas. The finding of ma-jor deposits of high-grade ore in South America, Africa, and Canada, together with a large scale, concentrated attack on the problem of pro-



Immense equipment is used in the milling of taconite

ducing high-grade ore from taconite, has alleviated, for the time being, any fear of an ore shortage.

#### Foreign Sources

During the last four or five years, the commercial development of these many prospects has been moving forward at a rapid pace. After building a 90-mile railroad, several town sites, loading facilities, and dredging the Orinoco River, U. S. Steel has begun to ship ore from its Cerro Bolivar deposit in Venezuela. Three million tons were shipped in 1954, and approximately 6,000,000 were shipped in 1955. Ultimately a substantially larger tonnage than this can be mined and shipped without any difficulty. The El Pao deposit of Bethlehem Steel, while somewhat smaller than Cerro Bolivar, also has many years of high-grade shipments ahead of it.

Along the remote and desolate border between Labrador and Quebec, another major mineral find has been opened up by the Iron Ore Company of Canada, a joint venture of six American steel and ore companies. A 360-mile railroad through the northern wilderness has been completed, along with towns, docks, a harbor and all of the other accoutrements necessary to the handling of large tonnages of material in remote areas. In 1954 1,700,000 tons were shipped from these properties, and approximately 7,500,000 tons were shipped last year. As much as 20,000,000 tons per year can be shipped from this area, if need be.

The Marmora Mine of Bethlehem, in Southern Ontario, began shipments last year. The Bristol Mine of Pickands Mather in Quebec, and Inland Steel's steep rock operation in Western Ontario, will begin shipments in a few years. All of these developments, combined with the new plants of International Nickel and Noranda Mines, which will produce iron sinter from pyrite and pyrrhotite, indicate that in the next few years Canada will be one of the largest iron ore producing countries in the world.

The development of major properties in Liberia and Peru also will swell the tide of imported ore serving the American steel industry. While all of this foreign development, at an expenditure of approximately \$700,000,000, has been going on abroad, 30 years of research and experimental work on the taconites of Minnesota, Michigan and Wisconsin was coming to fruition.

#### **Low-Grade Developments**

Taconite, as it is known in Minnesota, or jasper, as a somewhat similar material is called in Michigan, is a hard silicious iron bearing rock that contains 25 percent to 35 percent iron. In order to make it economically useable in the blast furnace, it must be ground to flour-like consistency (ap-

A. L. FAIRLEY, JR., spent the early part of his career as a geologist, first with the Tennessee Valley Authority and later with Tennessee Coal & Iron Division of U. S. Steel. In 1941 he was called to Washington to assist



in setting up the steel division of the War Production Board. He served two years as assistant deputy director of the Raw Materials Section, Steel Division. After three and a half years in the Air Force, he went to work for the Shenango Furnace Co. and its iron mining subsidiary. Snyder Mining Co. He has been with this organization ever since, and is now vice-president of the Shenango Furnace Co. and vice-president and general manager of Snyder Mining Co.

proximately 150 mesh) must then have the iron particles separated by magnetic concentration, flotation or other means, and must then be put together again in the form of pellets, nodules or sinter. The capital investment involved in developments of this magnitude is beyond belief. In an industry accustomed to thinking in terms of an investment of \$3.00 to \$4.00 per ton of annual capacity for direct shipping merchant ore, it required a major readjustment of finan-

cial perspective to realize that \$30 to \$40 per ton of annual capacity must be expended in invested capital in order to produce ore from taconite. It is to the credit of the iron and steel industry that these decisions were boldly made, and work has been progressing apace on these various projects.

The Reserve Mining Co., which has been operating a large scale pilot plant for several years, has now opened its mine, completed a 47-mile railroad, built a complete harbor on the shores of Lake Superior at Silver Bay, Minn., and is in the process of completing the beneficiation plant. Shipments began in 1955 and by 1957 over 3,000,000 tons per year of highgrade pellets will be moving from this operation.

Erie Mining Co., which also has had a commercial scale pilot plant in operation for several years, is progressing rapidly on its major taconite development, which in its first stage will produce 7,500,000 tons of pellets per year. Here a 73-mile railroad is being built, along with a complete harbor and docks, towns, etc. Shipments will begin from this operation in 1957.

Cleveland-Cliffs has two low grade ore operations under way in Michigan, and U. S. Steel's Oliver Iron Mining Division has two large scale pilot plants operating on the Mesabi Range. Practically every iron mining company is working on some process for up-grading low grade ores and for producing a better product. Each of these operations must be tailor-made to suit the situation at each individual location. By the time the projects now under way are completed, approximately \$600,000,000 will have been spent in the development of these low grade deposits. When this amount is added to the \$700,000,000



A vessel being loaded from an ore dock at the head of the lakes



Transportation costs are an item to be reckoned in the economy of iron ore



The fate of the iron ore industry depends upon the activity at the iron and steel mills



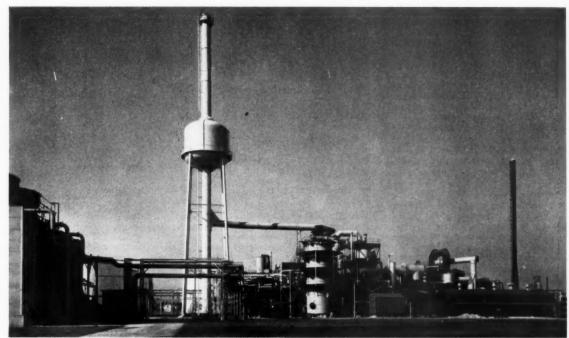
Iron ore has made Puerto Ordaz, Venezuela, an important world pert

being spent in the development of foreign ore sources, it is evident that a total of nearly \$1,300,000,000 will have been spent in capital outlay, in just a few years, in order to assure an adequate ore supply for the American iron and steel industry. Thus it can be seen that the iron ore industry has been moving steadily forward.

#### A Look to the Future

With this expansion in productive capacity well along toward completion, what can be expected in the future? As we all know, the fate of the iron ore industry hinges directly on the demand for iron and steel. During the 1954 slump the prophets of doom were claiming that the steel industry had over-expanded, and that it would take years for the economy of the country to catch up with it. Evidence can now be seen everywhere of just how wrong this philosophy was. Here, just 12 months later, there are actually shortages of many steel products, and this tremendous demand has developed without the artificial stimulation of a war or other international incident. Furthermore, within the last six months the presidents or chief executives of almost every major steel company have made public statements to the effect that a tremendous expansion of steel producing facilities will be necessary over the next 10 to 15-year period. A careful study of these various prognostications seems to indicate that there may be an expansion of as much as 40,000,000 ingot tons in the next 10 years. When we consider that the present ingot capacity of this country is 126,000,000 tons, this would mean that an expansion of 31 percent might be anticipated in the next decade. Any such increase as this in ingot capacity will, of course, call for a proportional increase in iron ore production. Much of this increase will undoubtedly come from the new foreign developments, which are nowhere near their maximum productive capacity at the present time. However, there is a limit beyond which, as a matter of policy, the American steel industry cannot afford to depend on water borne foreign ores, and when this limit is reached it will then be necessary to push with increased vigor the development of our own low grade deposits, wherever they may exist, within the borders of our country. Despite the minor inroads of plastics and other metals, nothing has yet been found which can economically replace steel in the over-all needs of the world economy. And, as steel moves, so moves iron ore.

The last 10 years have been a period of rapid change, rapid development and expansion in the production of iron ore. The next 10 years bid fair to be an era of even greater expansion, greater change and greater challenge.



New regeneration plant of the Stauffer Chemical Co. in Texas where sulphur is recoverd from "scrap acid" of the petroleum industry

# Sulphur

Continued Development of New Sources and Markets Enables the Domestic Sulphur Industry to Remain Self-Sufficient With a Surplus for Export

By W. W. DUECKER and E. W. EDDY
Texas Gulf Sulphur Co.

THE continued high level of domestic consumption and exports resulted in the shipment of 6,300,000 long tons of native and recovered sulphur from sources within the United States. This tonnage, the highest on record, is 550,000 long tons, or 10 per cent greater than in 1954. Domestic sales were stimulated by the high rate of activity in the steel, detergent, petroleum, chemical, and other acid-consuming industries.

#### Sources and Outlets Change

The primary source of sulphur in the United States is native sulphur produced from domes by the Frasch process and from surface mines. In addition sulphur is also available as (1) pyrites and smelter gases; (2) as recovered sulphur, such as is obtained in processing sour natural or cokeoven gas or petroleum refinery gases; and (3) other sulphur compounds which term includes scrap sulphuric acid, waste hydrogen sulphide, and liquid sulphur dioxide. The year was

#### About the Authors

W. W. DUECKER and E. W. EDDY again picture the sulphur industry's progress for Mining Congress Journal readers. Dr. Duecker and Mr. Eddy are statisticians with Texas Gulf Sulphur Co. and have an intimate knowledge of the subject on which they write.

marked by an expansion of these sources. In discussing this expansion the conditions of today will be compared with those existing in 1941, a year in which domestic conditions were not greatly influenced by war conditions. The over-all production and consumption data for 1941, 1954 and 1955 are shown in Table I.

#### **Native Sulphur**

Frasch sulphur still supplies the largest part of the sulphur market: 67 percent in 1955, compared with 68 percent in 1941. There are now 13 Frasch process mines in operation in the United States producing native sulphur. In 1941 there were only five. The Freeport Sulphur Company operated three mines in Louisiana at Grande Ecaille, Garden Island Bay, and Bay St. Elaine. It brought into production the Chacahoula Dome and was developing the Lake Pelto sulphur deposit about 60 miles southwest of New Orleans. In Texas the same company produced sulphur from the Nash Dome and from the Hoskins Mound which was finally shut down in May 1955 after 33 years of continuous production. Jefferson Lake Sulphur Company continued produc-Jefferson Lake tion at Starks Dome in Lousiana, and Clemens Dome and Long Point Dome in Texas. The Duval Sulphur and Potash Company produced sulphur at Orchard Dome in Texas and the Standard Sulphur Company mined the Damon Mound in the same state. The Texas Gulf Sulphur Company obtained sulphur in Texas from Boling Dome, Moss Bluff Dome, Spindletop Dome, and a portion of the output at Long Point.

The year also marked the recovery of sulphur from surface ores. The Yerrington, Nev., plant of The Anaconda Company obtained sufficient sulphur for a contact acid plant with a rated capacity of 450 tons 100 percent acid a day by burning a surface ore obtained from the Leviathan mine in California. The American Sulphur and Refining Company is constructing a plant at Sulphurdale in Beaver County, Utah, to extract sulphur from a surface deposit mined in the days of the Mormons.

#### **Pvrites**

The volume of pyrites and smelter gases used in the manufacture of acid has increased in the years since 1941. Proportionately, however, this source has declined in importance and now supplies but 11 percent of the sulphur market in comparison with 21 percent in 1941. One reason for this decline is that this type of sulphur is produced in connection with the extraction metals such as copper, lead and zinc. The domestic production of these metals has not been increased materially and hence the relative importance of sulphur from this source has declined. A new pyrites burning plant for the production of acid was completed in 1955 by the Rico Argentine Mining Co. at Rico, Colo. Domestic sources of pyrites continued operating at high levels and imports of pyrites from Canada increased from 140,122 net tons of sulphur content in 1954 to an annual 1955 rate of 165,000 net tons based on a nine months' period. Production of sulphuric acid from smelter gases continued at a high rate augmented by plants completed in 1954 at Galena, Kansas, and Kellogg, Idaho. The Garfield Chemical and Manufacturing



Plant of the Texas Gulf Sulphur Co. where sulphur is loaded into barges

Company in Utah announced plans to increase its acid capacity at its smelter from 750 to 1000 net tpd.

#### Recovered Sulphur

Today 43 plants are recovering annually more than 400,000 tons of sulphur from hydrogen sulphide derived from sour natural gas, petroleum refinery gases and coke oven gases. In 1941 sulphur was obtained only from coke oven gases.

#### Other Sulphur Compounds

During the year there was an expansion in plants which use waste sulphuric acid sludges in the manufacture of acid. "Scrap acid" is an increasing source of sulphur. This is acid which has been used and reclaimed by the petroleum, chemical, rayon and other industries. In some

instances it is used directly after being cleaned, fortified or concentrated. This is shown as "recycled acid" on the accompanying Consumption Chart. In most cases the "scrap acid" from the petroleum industry is completely decomposed and made into new acid. This is shown as "acid sludge" on the chart. In 1941 spent sulphuric acid was the only important source of other sulphur compounds. It was used directly in fertilizer manufacture or fortified at contact sulphuric acid plants or cleaned and concentrated. The volume of this type of recovered sulphur was equal to about 11 percent of the total market. Today this source, together with "recovered sulphur" supplies a million more tons than in 1941 or 21 percent of the total market. The greatest advance, however, has been made in the recovery of sulphur from hydrogen sulphide.

#### Markets

The increasing needs for sulphuric acid are responsible for the heavy demands for sulphur. Most of the sulphur used in the United States is converted to sulphuric acid. In 1955, 82 percent of all sulphur consumed in all forms was used for acid as compared with 75 percent in 1941. The major consumer of acid continues to be the fertilizer industry. Non-acid uses for sulphur increased but not at a high rate. This is due to a shift in the pulp and paper industry where pulp is made by the sulphate process which uses salt cake instead of sulphur. The growth in the pulp industry has been in sulphate pulp whereas sulphite pulp requiring sulphur has shown little change.

#### Mexico and Canada

The development of sulphur resources of Mexico continued. The Mexican Gulf Sulphur Company produced about 50,000 long tons in 91/2 months in 1954 and 100,000 tons in 1955. Pan American Sulphur Company, which produced nearly 400,000

TABLE I—UNITED STATES SULPHUR Long Tons Equivalent Sulphur

| Dong Tons 12   | darrateur isaib   | iidi  |  |  |
|--|---|---|--|--|
| PRODUCTION   | 1941(1)   | 1954(2)   | 1955(°)<br>Estimated   |  |
| Frasch process Surface mine Recovered sulphur  | 8,902   | 5,515,543<br>64,333<br>357,662                                      | 5,700,000<br>60,000<br>400,000   |  |
| Total  | 3.144,746   | 5,937,538   | 6,160,000  |  |
| APPARENT SALES   |   |   |  |  |
| Domestic   | $\substack{2.351,440 \\ 729,474}$                           | $\frac{4,018,676}{1,647,011}$                                       | $\substack{4,650,000\\1,600,000}$  |  |
| Total  | 3,080,904   | 5,665,687   | 6,250,000  |  |
| INVENTORY  |   |   |  |  |
| December 31, Frasch and Recovered.   | 4,685,804   | 3,337,086   | 3,200,000  |  |
| OTHER FORMS  |   |   | *  |  |
| Pyrites production Pyrites imports Smelter gases Hydrogen sulphide and sulphur dioxide Sulphuric acid recycled Acid sludge reconstituted | $\begin{array}{c} 166,000 \\ 215,000 \\ 21.197 \end{array}$ | 405,310<br>125,000<br>258,000<br>80,000<br>575,000(3)<br>190,000(3) | $\begin{array}{c} 400,000 \\ 140,000 \\ 280,000 \\ 80,000 \\ 650,000 \\ 250,000 \end{array}$ |  |
| SULPHUR IMPORTS APPARENT DOMESTIC CONSUMP-   |   |   | 50,000(5   |  |
| TION   | 3,400,000   | 5,650,000   | 6,500,000  |  |

Bureau of Mines. Preliminary data, Bureau of Mines. Authors' estimates. Canadian.

long tons in 1955, announced that it was increasing its plant capacities. It is reported that the Gulf Sulphur Corporation has completed a plant on the Salinas Dome, Isthmus of Tehuantepec. The Mexican producers shipped about 200,000 long tons of sulphur during 1955.

New supplies of sulphur were developed in Canada in 1955. The Noranda plant at Welland, Ontario, used a new process to make sulphur and sulphur dioxide from pyrites for use in a nearby acid plant. Plans were announced to build a similar plant to supply sulphuric acid for uranium operations at Blind River. At Kimberly, British Columbia, the Consolidated Mining and Smelting Company completed a fertilizer plant using pyrites and pyrrhotite tailings as the sulphur source.

Exploration by several mining companies in New Brunswick continued throughout the year and reports indicate that large tonnages of copper, lead and zinc-bearing pyrites have been blocked out. With the development of these areas, Canada is potentially a very important factor in the world's supply of sulphur.

Canadian Industries, Limited continued to produce about 40,000 net tons a year of equivalent sulphur in the form of liquid sulphur dioxide at

Sudbury, Ontario, at the smelter of the International Nickel Company. The capacity of the sour gas sulphur recovery plant at Jumping Pound operated by the Shell Chemical Company was doubled during the year and the Canadian Gulf Oil Company has announced the start of construction of a large similar plant at Pincher Creek, Alberta. The latter will have a capacity in the neighborhood of 80,000 long tons sulphur annually.

#### **Production Expands**

The United States continues to be self-sufficient in sulphur supplies with surplus available for export in spite of increasing domestic requirements. Stocks of sulphur, however, are not as large as they were some years ago. At the end of the year stocks of native and recovered sulphur were 3,200,000 long tons or 150,000 long tons less than last year.

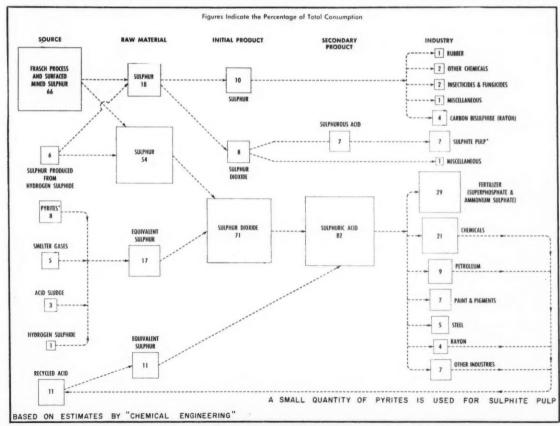
The search for new sulphur domes pushed out to sea. During the year the Humble Oil Company announced the discovery of a major deposit in the Gulf of Mexico off the Louisiana Coast and officials of Humble estimate it contains 30 to 40 million tons of sulphur. The Shell Oil Company has paid \$1,223,000 for off-shore sulphur leases in the same general area. Texas Gulf Sulphur Company has paid

\$7,100,000, and Freeport Sulphur Company \$1,261,000 for sulphur leases off the Texas Coast.

Export prices for U. S. sulphur settled at a level of \$31 per long ton in vessels, at loading ports. The domestic price of sulphur was \$26.50 per long ton at the mines and \$28 at loading ports. Sulphur produced at plants processing sour gas commonly sold at prices comparable with those of Frasch sulphur, Much, however, is captive sulphur, consumed by producing companies. Continued demand for shipping space, notably in the North Atlantic Coal Trade, has resulted in a steady increase in sulphur freight rates both coastwise and overseas.

#### **Molten Sulphur Shipments**

The trend toward shipping molten sulphur in the liquid state continued. The first tank car of liquid sulphur was shipped to a manufacturer of acid in 1945. The first commercial barge shipment of liquid sulphur was made in 1952. At present liquid sulphur is being shipped in tank cars, in tank wagons and in tank barges. An ocean going vessel equipped with tanks for chemicals and for molten sulphur was put into service between Gulf Ports and New England during the year.



Consumption of sulphur from all sources, by industries in the United States 1952-55 average



The new primary aluminum producing plant of the Anaconda Aluminum Co. at Columbia Falls, Mont.

# Aluminum Outlook

Growth of the Aluminum Industry Continues
Unabated; Civilian Markets Take 91 Percent
of Total Supply as Consumers Demand
Increasing Quantities of New Items

By WALTER L. RICE

President Reynolds Mining Corp.

THE outlook for the United States aluminum industry is more promising than ever before. United States primary aluminum production in 1955 is estimated at 1,537,000 tons, five percent higher than in 1954 and 113 percent higher than in 1950. In 1956, primary aluminum production in the United States is expected to exceed 1,600,000 tons. Although the United States primary aluminum industry has broken its own production records again and again, the demand for aluminum has risen even more sharply.

#### **High Non-Military Demand**

Today's high demand has been brought on primarily by the continued growth of regular peacetime markets, not by any heavy military or defense consumption of aluminum. Although it was Korean War mobilization requirements which triggered the dou-

bling of primary capacity since 1950, defense uses account for very little of the nation's current aluminum consumption. At the peak of military consumption during the Korean emergency, in 1952, about 30 percent of the nation's aluminum supply went into defense uses. This year it is estimated that the military will use less than 10 percent of the total supply.

With the demand for aluminum strong and increasing all over the world and with prices generally higher than prevail in the United States, net primary aluminum imports decreased from 32 percent of domestic primary production in 1950 to 13 percent in 1954 and 1955. During this period, the rapidly increasing aluminum markets have therefore received more of their requirements from domestic sources than ever before.



The Reynolds Mining Corp.. which WALTER L. RICE serves as president, mines bauxite and fluorspar in the United States and foreign countries. Mr. Rice is also director, vice-president and general solicitor of Reynolds Metal Co. and president of Reynolds Jamaica Mines, Ltd., Tropical Steamship Co., Ltd., and Caribbean Steamship Co., Before joining the Reynolds organization, Mr. Rice, a lawyer, had a brilliant career in the legal profession, practicing in New York and later as special assistant to the United States Attorney General.

The domestic primary aluminum industry has responded to this rapidly rising demand by expanding capacity and production. The prevailing view in the industry is that aluminum markets will not only stay large but will continue to grow for the foreseeable future. Civilian markets in 1955 are expected to have taken 2,050,000 tons of aluminum or 91 percent of total supply. These markets doubled since 1952 when only 1,330,000 tons were absorbed and they are demanding more aluminum. Recent application

and market developments indicate why this demand will continue to grow.

#### **Expanding Markets**

In the automotive market, the trend toward the use of more aluminum per car continues. It is being stimulated by rising copper and zinc prices and the improvement in various types of color finishes on aluminum. Since 1950 aluminum consumption by the automobile industry has doubled.

Since 1950 aluminum consumed in building and construction applications has also doubled. Aluminum windows and combination storm and screen windows have become large aluminum markets, along with the already rapidly developing roofing and siding market. Aluminum panel walls of various types, including color anodized extrusions, are further increasing this market. Builder's hardware, architectural shapes and accessories are also fast growing branches of this market.

The electrical market has experienced a sharp increase in aluminum consumption during recent years. The widening gap between the prices of aluminum and copper, plus the certainty of aluminum supply during recent years are the spurs to its greater use in this industry. Western Electric is the latest large user to announce publicly that it is engineering into aluminum as fast as it can.

Many of the applications of aluminum in consumer goods such as refrigerator shelves and evaporator units have long been standard. New color finishes and improved products such as "tubed sheet" are playing an important part in expanding this market. The appliance market had been large in 1950 but was still larger in 1955, consuming 530,000,000 lb in 1955. The widespread popularity of wrapping foil and the large-scale promotional merchandising and advertising by the



Bauxite operations in Arkansas

leading aluminum companies are increasing the public's familiarity with aluminum and are contributing factors in the development of this market.

The machinery and equipment market is another expanding outlet for aluminum. The major development in the agricultural field has been the increasing and nation-wide adoption of irrigation as regular, year-round food growing equipment to assure continuous water supply for crops.

A variety of new packaging applications, including frozen dinners and all types of bakery preparations and products, are constantly enlarging the rapidly growing packaging and containers market. This market has had

a sharp growth during the last few years after being severely restricted during the Korean War because of heavy military demands.

The railroad industry is showing more interest than ever before in aluminum for its passenger rolling stock. The pressure to cut passenger deficits and to improve service has been sufficient to persuade various railroads to invest in some new trains using aluminum.

#### Raw Materials and Energy Supplies Plentiful

These market developments mean a continuous expansion of the industry's production, requiring new plants and more raw materials.

No bottlenecks are expected. Bauxite supplies are plentiful, being available in large quantities from numerous Western Hemisphere sources including Arkansas, Jamaica, Surinam, British Guiana and Haiti.

Power is also being made available in adequate quantities. During the past decade, natural gas has become an important source of electrical energy for aluminum production, along with hydro power. Now there is considerable interest being shown in coal as an economical source of power. About half of the industry's pending expansion program is based on the use of coal for its power generation.

With markets growing and necessary resources available to meet the increasing demand, the aluminum industry is understandably optimistic about its immediate and long-term future.



Less than 10 percent of the aluminum supply was used by the military in 1955

# **Mechanical Coal Mining**



Indicative of the aggressive attitude of equipment manufacturers was the appearance of some newly designed machines

#### Continuous Mining Moves Into New Era, While Greater Emphasis Is Placed on Polishing Present Techniques in Conventional Mining

By RALPH E. KIRK

Consulting Engineer Birmingham, Ala.

ADVANCES in mechanical coal mining in 1955 continued to reflect the determination of leading interests among coal producers and equipment manufacturers to improve further and substantially the competitive position of coal in fuel markets at home and abroad, with comparable improvement in accident prevention. There are unmistakable indications that these efforts are meeting with a gratifying degree of success which can be confidently expected to continue with increased tempo.

The trends noted in previous years, from hand loading methods and from mobile loading machines loading directly into mine cars, toward trackless mining and continuous mining were continued during 1955. Where mobile loading machines are in use, the

trend from loading into mine cars to shuttle cars will probably continue for some time. However, developments in 1955 in room conveyor designs, primarily designed for servicing continuous mining machines, suggest the

probability that adaptations of this type of transportation will be made for use with mobile loading machines.

In 1955 there were gratifying indications that forward-looking operating managements recognize that a program of mechanical mining is only begun when equipment is purchased. Training of supervisory personnel, provision of adequate maintenance facilities, including a mple spare equipment, employment of sufficient thoroughly competent maintenance personnel, and time studies worthy of the name, all have been proved by experience to be indispensable adjuncts to mechanical mining programs before the full fruits of comparatively large expenditures can be realized.

#### CONTINUOUS MINING

Continuous mining equipment seems to be ushering in a new era of production. Improved designs of earlier machine and newly-designed machines attracted widespread and favorable notice. Reports of production performance that would have been considered fantastic only a few years ago became commonplace.

Nonetheless, there was increasing evidence that continuous mining equipment cannot completely justify use of the term until there are parallel developments in auxiliary equipment for transportation, rock dusting, dust control, ventilation, roof support and face lighting.

In 1955, in a few instances, this

widely used term was approaching reality, in varying degree and on what was still essentially experimental or at least pioneering efforts. Indicative of the aggressive attitude of equipment manufacturers was the appearance of some newly-designed machines and of other machines wherein design in various details had been materially improved by the manufacturers as one result of extensive trials under a variety of conditions.

However, on the heels of this acknowledgment of manufacturers' achievements, candor compels the qualifying statement that comparatively little has been accomplished so far in getting machines of this type on the market for use in thin seams, pitching seams, and seams containing thick or very hard rock partings. In fact, expressions of doubt are rather frequently heard that design of any of the types of such machines now on the market will prove successful in coal seams less than 36 in., or for cutting out or through hard rock partings, or for seams with abrupt and severe changes in roof or bottom strata, or on even moderate pitches.

Some experienced operators in seams having adverse conditions such as those here listed profess far more faith in development of machines of auger type to meet these conditions rather than in adaption of any continuous-type mining machine presently available.

It is axiomatic that the successes of yesterday lead to the successes of today which in turn lead to the successes of today which in turn lead to the successes of tomorrow. The successful development of today's continuous miner stems from the successful development of the carbide insert bit, which in turn evolved from the successful use of the chain type undercutting machine. Trackless mining had enjoyed a good measure of acceptance prior to the successful development of modern roof bolting, but was adopted much more readily and widely thereafter. When the potential of the early continuous-type

miners became fully apparent, it was soon recognized that much greater possibilities could be realized by improvements in designs of the machines themselves, and just as importantly, in design of auxiliary equipment for transportation, roof support, ventilation, allaying of coal dust, in rock dusting, and lighting.

#### Continuous Transportation Advances

In transportation of freshly-mined coal from the continuous type face machines to the main transportation system of the mine, the industry generally has been obliged to rely largely on a "batch type" of transportation equipment, namely, the shuttle car, to service a "continuous-type" of face machine. The number and variety of expedients evolved need not again be described here. Suffice it to comment that none was eminently satisfactory. None could be depended upon to keep the face machine operating at least 80 percent of the available time. Excessive spillage at some point was a common experience.

Obviously, for a continuous extractor machine at the face, a continuous transportation unit was a must, as was a connecting link between the discharge end of the miner and the receiving end of the room transportation unit

Again obviously the need for a continuous type of transportation suggested the conveyor. Just as obviously, the types of conveyors then available, although used rather extensively, had inherent limitations that precluded acceptance of them as a satisfactory solution to the problem.

The original problem was accentuated by the recent development of face machines which demonstrated ability to double without difficulty the rate of extraction of earlier types.

In 1955, at least two manufacturers had done notable development work on mobile type belt conveyors. Reports of performance indicate that After beginning his mining career during college days by spending his summer vacations working in and around coal mines, RALPH KIRK went to work with a construction company after graduation from Pennsylvania State University. Shortly thereafter he rejoined the



mining industry as assistant to the chief engineer of the Bessemer Coke Co. Since that time he has had broad experience in operating and administrative capacities in the bituminous and anthracite mining industry. In 1943 he became manager of raw materials for the Tennessee Coal & Iron Division of U. S. Steel Corp. with responsibility for the production of iron ore, coal, limestone, and dolomite for use in TCI's manufacturing plants. He is now a member of the firm, Kirk and Cowin, consulting registered professional engineers in the minerals industries.

an important step has been taken in continuous mining by the development of an adequate transportation link, from face miner to the main mine transportation system, and of approximately equal capacity to the face machine.

In mines having wet and soft bottom the mobile belt conveyor should be an economical and welcome successor to the shuttle car.

From an accident prevention standpoint the mobile belt conveyor transportation is doubtless an improvement as compared to shuttle car operations.

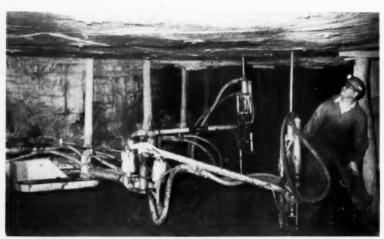
Although revamping of mine projections is clearly indicated in some instances, to take full advantage of the opportunity afforded by the mobile belt conveyor to drive long rooms, the revisions would consist mainly of dimensional detail regarding spacing of rooms, entries and pillars rather than any fundamental differences from previous room-and-pillar mining.

#### **Auxiliary Equipment**

In auxiliary equipment, substantial progress has also been made in equipment designed to keep related activities at the face closely geared to the advance of the continuous miner. Notable among these have been provisions for roof bolting.



Developments in continuous transportation were pushed



Roof bolting advances include progress in the development of bolting equipment geared to the advance of continuous mining

Progress has been made in two diverse directions:

- 1. Mounting drills on the continuous miner.
- 2. Development of a roof bolting machine, separate from the miner.

Both approaches have commendable features. At this time, experience is not sufficient to permit conclusive judgment regarding the merits of either device.

A brief description follows of the self-propelled electric-hydraulic driven car equipped with two air-actuated stoper arms which cover a face up to 25 ft wide. The handling of stopers by hand is eliminated. Another desirable feature is the collection of dust through the bit and drill steel, thus eliminating the need for accessory equipment for that purpose.

The same stoper arm has been mounted on a self-propelled permissible mine car compressor by the same manufacturer, thus supplying a complete self-contained power unit for roof bolting purposes, with air for stopers, dust collectors, and impact wrenches.

Rotary drilling equipment has likewise been progressively improved and can today be considered a thoroughly acceptable accessory to the continuous-type face machine, and the choice of many experienced operators for use under less dense types of roof rock.

#### Rock Dusting

Rock dusting and sprinkling have been two troublesome elements to coordinate with other operations at the face. Especially in continuous mining, a means had to be found by which rock dust could be applied other than by being blown dry on the coal surfaces. Otherwise, air-borne dust affected the visibility of men working on the return side of the air current.

During a three-month period experimental work was carried on by a prominent mine operator and leading manufacturer of rock dusting equipment in conjunction with the Federal Bureau of Mines and the Kentucky Department of Mines. Sprinkling water from the line under 200-psi pressure and dry rock dust from a standard type rock dusting machine were mixed in a gunite nozzle and applied to the roof and ribs in slurry form, with 6.5 gal of water being used with 100 lb of dry rock dust. Dry dust was used on the floor to avoid creating a wet and slimy condition.

Limitations of space preclude lengthy description here of the detailed techniques employed or the summarized results. The published comment of the operator's representative states at the end of his detailed presentation at the Kentucky Mining Institute, November 11, 1955, as follows: "Our conclusion is that it is practical and possible to apply wet rock dust during the continuous mining cycle."

#### Here to Stay

In concluding this discussion of continuous mining, mention may be made of the almost even division of leading manufacturers between the "boring" type and the "ripper" type. One manufacturer offers machines of both types. The great majority of machines in use today belong to one of these two classes. The earliest type of today's machines, the "ripper", is still ahead in number of machines in actual use, but the "boring" type is rapidly gaining acceptance, especially in the thicker seams.

It has been reliably estimated that the approximately 400 active machines of the continuous mining type would produce nearly 25,000,000 tons of coal in 1955, or nearly 8.0 percent of the total underground output. This estimate is roughly three times the production from continuous type machines in 1952, of 8,200,000 tons,

Predictions that the use of continuous-type miners will ultimately result in production of 100 tons per face man-shift and 1000 tons per unit-shift, and that continuous type miners can be used for pillar extraction are being accepted rather widely.

Continuous mining is here to stay.

#### CONVENTIONAL MINING

Development of equipment and innovations in operating plans and practices during 1955 were noteworthy in a number of respects. Not as spectacular as some of the developments in continuous mining, progress in conventional mining consisted of improvements, refinements and adaptations of designs considered proved in principle.

#### Thin Seam Equipment

Equipment designed for use in thin seams was given increased attention by manufacturers seeking as always to broaden the base of their market. At least three crawler-type loaders were specifically designed for thin seams, with the apparent intention of utilizing bridge conveyors and probably the newly-developed types of mobile belt conveyors for transportation of coal from the loader to the main transportation system of the mine. However, a new low shuttle car, 29 in. high, was announced by one manufacturer. This car, ruggedly

constructed, features new 4-wheel hydraulically powered steering, 4-wheel positive drive, improved pedal control and a manually operated conveyor clutch. Stated capacity is 100 cu ft.

With rated capacities of the loaders previously mentioned ranging from four to six tpm, prospective purchasers of such high capacity face equipment must give more careful consideration than ever before to the transportation problems between loader and main mine transportation.

Further indication of interest of equipment manufacturers is found in newly-designed stopers for use in seams as low as 26 in., weighing less than 70 lb and equipped with a dust collecting system. Significant of similar recognition of the need for light and efficient tools for use in close quarters, are hand-held hydraulic drills ranging in weight from 25 to 35 lb for blasthole drilling at the face.

Of interest also is the announcement of a rock dust distributor only 15 in, high with hopper and wheels removed. The machine is reported capable of discharging 30 lb of rock dust per minute through 400 ft of two-in. hose. A wet-dust nozzle, for introducing water into the stream of rock dust is available if desired.

#### Roof Support

The search for ideal equipment for roof support in long face mining continued in 1955, with no reports at hand of notable success.

Appeal of long face mining methods, especially in the thinner seams, is reborn whenever a new type of equipment is introduced that offers hope of solving the age-old problems encountered in practical operation. Recent years have seen the importation of various types of tools designed for long-face mining. Some local successes have been reported, but again, practical difficulties encountered seem to have dampened enthusiasm for large-scale pioneering with this method in America.

#### **Cutting Machines**

In cutting machine design there were no spectacularly new models, but some further improvements were made in machines now being marketed. Considerable increased interest was noted in bugdusters for the universal type machines. One manufacturer has increased the speed of his hydraulically-driven scroll-type bugduster 20 percent.

Six tramming speeds forward or reverse, to permit tramming on a  $15^{\circ}$  pitch, or tramming as fast as 200 fpm was also featured.

A universal type machine, only 26 in high, can be equipped by the manufacturer with a piping arrangement for operating a hand-held hydraulic drill from the circuit of the machine.

#### MORE FACTS ON ROOF BOLTING \_

The article "Some Roof Bolting Costs" in the January issue of Mining Congress Journal created such interest that these additional facts are presented for the information of Journal readers.

- Coal production from mines using roof bolts averaged 18,500,000 tons per month in 1955.
- 2. Roof bolt consumption increased from 2,000,000 bolts per month in 1954 to 3,000,000 bolts per month in 1955.
- 3. Roof bolting was practiced in 430 coal mines, a slight increase over 1954.
- 4. Of the mines using roof bolts, 14 percent used slotted type bolts, 70 percent used expansion type bolts and 16 percent used both
- 5. No wooden roof bolts were used as such, but several mines used wooden pins to hold ribs in place.
- 6. In 38 percent of the roof bolting mines percussion drilling was used to drill the bolt hole. Rotary drilling was practiced in 41 percent, and in the remaining 21 percent, both were employed.
- 7. Dust collectors were used at 48 percent of the operations, while water was employed to allay dust drilling at 16 percent of the mines. At 30 percent of the roof bolting mines there was no method of dust abatement. The remaining six percent practiced dust control on some roof drilling units but not on others.

#### Shuttle Cars

New shuttle car designs, in addition to the thin seam car already mentioned, included a heavied-up model of a type previously used. Particularly adapted for the thick and moderately pitching seams of the West, these cars are reported to carry their full load of 12 tons up eight percent grades without difficulty. Two 25-hp motors drive the rugged wheel units over uneven bottom under full load with comparatively little down time being experienced according to late

reports. The large capacity car is also available in a lighter model, at less first cost, where there is need for a large capacity car but the service conditions are less severe than where the "Super" type car is used.

Accessory equipment, such as circuit centers, cable fault finders, vulcanizers and roof bolts and roof bolting tools were improved in various ways during the year in too numerous detail to permit any adequate listing within the limits of this article.

Equipment for rapid and safe transportation between surface and face, and between points in the mine of personnel, other equipment, and supplies was also improved in a considerable variety of detail.

#### **Important Experiments**

A protracted experiment in face lighting has been in progress for more than a year. Statistical appraisal of advantages is practically impossible. However, it seems certain that beneficial results were obtained in better supervision and housekeeping, improvement in casualty, etc.

Experimental work with auger mining in underground mines continues, although presently on a comparatively small scale. Opinion persists in some quarters, especially in connection with operations in thin seams, that eventual development of suitable equipment is a certainty.

Important experimental work was done by at least one operator with (Continued on page 136)



Interest in bug dusters for universal type cutting machines was revived



The maneuverable gooseneck trailer unit with positive ejection trailer is used especially where sticky materials are handled

## **Open Pit Mining**

The Significant Developments in Methods and Equipment used in Surface Mining Everywhere are Summarized

#### By PROFESSOR EUGENE P. PFLEIDER

Head, Department of Mineral Engineering School of Mines and Metallurgy University of Minnesota

AS in all phases of mining, the open pit operators had a boom year in 1955. Demands for higher production and increasing labor costs have forced him to better his unit output. This not only meant more efficient use of existing units, but also a switch to new equipment of different principle and greater capacities. Fortunately, the new depreciation laws now permit him to make these changes sooner, and he is well advised to balance operating economies against capital writeoff charges. The term Operations Research is becoming more meaningful, and the manager is beginning to call on the mathematician, with his skill in the application of a statistical approach, to assist him in getting optimum results from his costly equipment. The outstanding changes probably have been in the areas of drilling and blasting, but ironically these persist as the major problems to be solved in the future according to a survey of major open pit operators.

#### **Trends**

The trend from underground to surface mining continues as labor costs rise and earth-moving equipment becomes larger and more efficient. Butte is developing surface operations in addition to the Skryme pit along their low grade ore trend to augment production from the Kelly Shaft. The Anderson Phosphate Mine, an underground operation near Garrison, Mont. is expanding by stripping and mining the up-dip extension of their 3-5 ft bed of phosphate rock as it parallels the hill slope.

The Ray Mine of Kennecott Copper produced its last ton of underground ore, at least for the present, in converting over to a large scale open pit producer. But eventually high strip ratios win over where the dip of the ore body is high, and this is the history of the famous Kiruna open pit mines in northern Sweden. After producing tens of millions of tons of high grade ore (60-65 percent Fe) by

steam shovel and truck since early 1900, underground development work is nearing completion to take over the job of mining 50,000 tons daily through eight shafts by 1960. Similarly, Steep Rock Iron Mines are planning on an ever-increasing percentage of their capacity from the new block-caving project.

The large earth-moving contractors such as Isbell, Peter Kiewit, Morrison-Knudsen and Utah Construction are becoming familiar names in mining publications. The mining companies realize the many advantages, particularly for rapid stripping schedules, of having competent contractors with their skilled crews and varied equipment. It permits fast development at low capital outlay and a minimum amount of equipment required for the long term operation. In fact, the contractors have done so well that they now are becoming partners in such new developments as the large open pit iron property of Marcona Mining Co. in Peru.

#### **New Ventures**

During the year 1955 several new open pit ventures either became a reality or a definite plan on the drafting board. The Marmora Iron Ore mine of Bethlehem went into production in Ontario. The Reserve Mine at Babbitt became the first of the taconite operators to ship to a large scale plant when they delivered the initial tonnage to the E. W. Davis Works at Silver Bay on Lake Superior. Pickands Mather & Co. extended the producing limits on the far western end of the Mesabi Range by placing the Tioga Mine, alongside Pokegama Lake, into operation. Sev-

eral new low grade copper producers are in the planning stage in Peru and Chile, and a bauxite property is under development in Haiti. The Jackpile Mine of Anaconda is the first full fledged open pit operation of size in the field of uranium mining.

#### **Operations Research**

Thomas M. Ware, executive vicepresident of International Minerals, highlighted the need of a new scientific approach for planning the mine of tomorrow in a paper presented at the Mine of the Future series before the Centenary Congress in Paris, June 1955. This was amplified in the August 1955 issue of MCJ. Hence, the term Operations Research, and such formulas as

#### $T = \left[ r / \Theta / z \frac{1}{D} \right] \left[ t_d + 2t (r, z, \beta - \theta) \right] r dr d\theta dz$

become a new tool for the open pit operator. Most fields of engineering have made effective use of the mathematician, and mining undoubtedly can do the same in many areas. Large equipment working on a standard pattern lends itself particularly well to this approach, as pointed out by Dunlap and Jacobs in their article: "How Operations Research Solved the Dragline Problem," August E&MJ. These statistical methods can be employed in the development and operating layouts of orebodies, as interestingly described by W. R. Van Voorhis, et al. in their article: "Operations Research Applied to Ore Reserves at Riddle" in the September issue of MCJ. At this complex nickel deposit, resembling a stack of oval plates with the biggest and leanest horizons on the bottom and the smallest and richest on the top, the reserve estimate was tested for reliability by using the combined talents of the mining engineer, geologist, logician and mathematician. Ware predicts that this scientific methodology will be used in all phases of future mining activity including beneficiation process and equipment conversion and transportation. Although the production manager of the future will not be expected to handle such terms as confidence levels, logical constraints and partial differentials with ease, he should be familiar with them in presenting his problems to the specialist.

#### Soil Mechanics

The subject of Soil Mechanics is receiving increased attention, and here again management is calling on the services of experts. Bank stability and drainage become increasingly important as depths of overburden increase. Where ore deposits are covered with thick mantles of unconsolidated material, or are themselves only partially consolidated, the ex-ploration and development drilling should include some sampling and laboratory testing of these horizons. Such information is essential to the soils engineer if he is to diagnose the problem correctly. Texture, porosity, permeability, shear strength, liquid limits, etc., are the data he needs to set maximum pit slopes and to design operating roads and drainage facilities. Much money and time can be saved by being forearmed in this respect. The Annual Mining Sym-posium in Duluth in January 1955 featured the application of soils mechanics to open pit operations along the Mesabi and Steep Rock Ranges. Such subjects as the treacherous varied clays overlying Inland Steel's new operation at Steep Rock, and the use of the Electro-Osmotic method for stabilizing pit banks, were discussed. Pickands Mather solved a difficult problem of driving a conveyor EUGENE P. PFLEIDER has been teaching since 1948. Before that he had operating experience in open pit and underground mining in the United



States. South America and Cuba, including sulphur, tin, manganese, nickel and iron. In addition to his work with the Minnesota School of Mines and Metalurgy, he is now engaged in development of lateritic nickel ores of Cuba for The Freeport Sulphur Co.

way through glacial drift at their Tioga Mine by using sodium silicate and calcium chloride to solidify the material sufficiently to make headway.

#### Excavation

The trend continues toward larger units, the wider use of the draglines, and dieselization of the excavators up to 10-yd capacity. Two-crawler shovels of 10-yd capacity are now in service. Since the dragline has proven itself capable of handling well blasted material, it is being favored in many operations requiring reach. Furthermore, its capacity to elevate can save a considerable number of units in a truck fleet. The diesel powered excavator provides a mobility that oftentimes offsets the power cost advantage of an electric unit. As mentioned previously under operations research, dragline mining standards are being used to obtain optimum efficiency. Television, air conditioned cabs, and radio are operating aids that are becoming more commonplace.

Tractor shovels, both crawler and rubber-tire mounted, are finding increasing use as prime loaders at small mines and for clean-up and miscellaneous loading at larger operations. The tractor-scraper combination continues to be a useful excavating-transporting unit, particularly for the stripping phases. The tractors available for dozing are becoming veritable behemoths, the largest being powered by two 190 hp motors. The rubber-tired dozer is definitely here to stay, although the hard rock mines would like to see them built more ruggedly. The U-dozer blade is excellent for pushing, carrying 50 percent more load than the straight dozer. Skilled operators say they can do any-



Copper Cities property of Miami Copper—initial production November 1954

|     |   |     | LE  |     |
|-----|---|-----|-----|-----|
| . 1 | A | 151 | 1 1 | - 4 |

| Method   | Cost per cu. yd., cents      |  |
|--|------------------------------|--|
| Shovel and Wagon Self-propelled scrapers Tractor scrapers Walking dragline Hydraulicking | 45.9<br>37.9<br>26.6<br>11.8 | $\begin{array}{c} 43.0 \\ 62.7 \\ 74.6 \\ 386.2 \end{array}$   |
| Free Ejector Sand pump Dredge  | 7.3<br>11.5<br>8.8<br>8.5    | $\begin{array}{c} 136.5 \\ 87.2 \\ 295.3 \\ 300.0 \end{array}$ |

thing with a U-dozer that can be done with a straight or angle dozer.

#### Transportation

It is difficult to single out any particular new development in haulage equipment. The large trucks—up to 50-ton capacity-are gaining favor. The rocker-type unit, with its very short turning radius and maneuverability is replacing rigid frame trucks in the 15-35-ton class. Clayey material is still a problem, although heated boxes are now provided with the rocker box, and a new positive ejection trailer (Movall) has been developed. LeTourneau is considering adding an electric motor drive to the rear wheels of its Tournarocker in order to get four-wheel drive under conditions of bad traction. Such a drive would be used in the loading area, and disconnected when on haulage roads. More attention is being given to road building and maintenance. Wide high-speed roads, at lower grades and possibly surfaced with bituminous binder, are being built for permanent long haul installations.

Belt conveyors continue to transport over grades up to 17°, with the high tension belts eliminating transfer points. Lugged belts, capable of high angle operation, are on trial. The large inclined skipway, having 15-35-ton skips capable of holding full truck loads, is an excellent answer to elevating up slopes of 20°-60°. It permits level truck hauls to dump point and high capacity without requiring crusher installations in the pit. Marmora is the fifth operation using these large skips.

In pits having rail haulage, such as Morenci, 1750 hp diesel-electric locomotives are replacing trolley locomotives and adding markedly to flexibility. Power tools used on mainline have been adapted to mine track maintenance. New side dump cars of 60-80-ton capacity (40 cu yds) are increasing the efficiency of stripping and ore haulage for Oliver operations on the Mesabi Range. Central traffic control equipment has been installed at major operations to handle traffic by remote control of switches and signals. Radio communications systems also aid in effective dispatching. The new taconite operations are concentrating on large diesel-electric locomotives and 80-ton cars.

Hydraulic transportation still centers around the phosphate, clay, and bauxite operations. R. E. Sinke, in his article on stripping operations at Demerara Bauxite in British Guiana



The large dragline hydraulic monitor, and dredge type pump are the mainstays of some phosphate and bauxite producers

(Mining Engineering, April 1955) effectively emphasized the considerable advantage of hydraulic handling for loosely consolidated materials by giving the cost comparisons shown in Table I.

With the advent of rubber-lined pipe and more abrasive resistant pump impellers, the mining engineer should give increasing thought to hydraulic transportation, particularly if his product goes to a wet concentration plant and there is ample water supply in his pit.

#### Drilling

All facets of the industry - limestone, copper, iron ores, etc.-with the exception of the hard ore mines, are converting rapidly to rotary drills employing air as the flushing medium. The new heavy units, featuring high bit pressures, utilize Hughes tricone bits from 7% in. to 12% in. diameter. Shift advance varies greatly according to type of ground, but reports generally note that one new rotary replaces 2 to 5 churn drill units, cutting costs to 50 percent of former figures. The Joy Heavyweight and 60 BH and the Bucyrus 40-R and 50-R are accepted drills, with the heavier 50-R type predominating in medium hard iron ores requiring high thrusts and tungsten carbide roller bits. The dry cuttings collected from these drills make excellent stemming material.

The success of the rotary drill in increasingly hard formations can be attributed not only to the heavier units, but very directly to the development of the tricone bit to withstand high thrusts and wear. For abrasive rocks requiring high stress concentrations the Hughes R-2 type bit, with its tungsten carbide button inserts, has



Railroad operated pits closing in on underground operation—Mesabi Iron Range



Opening up a major taconite pit with jet piercing drill, shovel and trucks

been successful; giving average bit lives ranging from 2100 ft in medium hard copper ore, and 1400 ft in limestone, to 420 ft per bit in abrasive iron ores.

Those operations having extremely dense and cohesive rocks, such as the taconites of the Lake Superior region, the magnetites and ilmenites of New York, and the granite and trap rock quarries, still rely on the high impact loading of percussion drilling or the spalling action of Jet Piercing to drill their blast holes. The combined rotary and percussive action of the Ingersoll-Rand Drillmaster or Quarrymaster is gaining headway and represents a partial solution to this aggravating problem. The drill generally uses a six-in. tungsten carbide cross bit. Drill rates of 20-25 ft per hour and bit life of 1300-3200 is reported for the overburden and six ft per hour for the hard abrasive ore at the Marmora

Mobile drills, mounted on a tractor or rubber-tired wagon whose engine powers the compressor, are gaining favor at small open pit operations and for secondary drilling.

#### Blasting and Secondary Breakage

Certainly one of the outstanding developments of the last two years in blasting has been the adaption of ammonium nitrate, fertilizer grade, to the cheap and effective breakage of large volumes of rock and ore. Pioneered by George Akre and Hugh Lee of Maumee Collieries in Terre Haute, Ind., this combination of ammonium nitrate and six percent carbon black is packed in flexible plastic bags and generally referred to as Akremite. An excellent article in Excavating Engineer, December 1955, lists the following advantages: 1) not cap sensi-

tive and safe, 2) ingredients inexpensive and transportation costs low, 3) has high density loading by virtue of its packing characteristics upon expansion of bag in hole, and 4) gives uniform fragmentation, It requires a relatively smooth dry hole for effectiveness and a primer charge for detonation. The rights to Akremite have been secured by Du Pont, who in turn has licensed various other explosives companies. It, or similar types, are now in use in Labrador, the Mesabi range, various copper producers, and quite a number of limestone quarries, coal strippers, and metal mines througout the country.

High speed photographic methods, such as the machine gun camera, are

being used to study defects and comparative actions in varying blasting techniques. This visual information, coupled with the use of seismic equipment to record earth vibrations, and of micro delays for detonating both single and multiple rows, have done much to improve the efficiency of blasting. Every operator experiencing high blasting cost or poor fragmentation should seriouly consider these devices.

Secondary breakage is still a big problem where the material breaks large due to primary jointing or bedding. The mobile drill or portable compressor makes drilling and blasting easier now, but the drop ball technique has increased in use. Taconite and magnetite operators have found the drop ball crane to be a great aid in cutting costs and hazards of secondary breakage. The Blair Limestone Division of Jones and Laughlin Steel Corp. has devised a new connection, consisting of two U-bolts, a heavy spring, and a heavy duty swivel. that saves on cable costs.

#### **Outstanding Future Needs**

An industry wide questionnaire, answered by some 40 individual open pit operators, emphasized the following as their outstanding future needs:

1. A cheaper method of drilling hard abrasive rock.

A continuous method of mining and excavating that is cheaper than the cyclical shovel and dragline operations

3. Better fragmentation in blasting.
4. Reduction in gross weight of vehicles—still retaining strength.

An increased number of sizes and types of rubber-tired tractors.

(Continued on page 106)



The rotary drill and Akremite type explosives in plastic expandable bags mark advances in drilling and blasting



One of the 13 privately owned mills on the Colorado Plateau

## Uranium

1955 Sets Records to Be Surpassed in 1956

By ERIC R. RUDE

Division of Raw Materials United States Atomic Energy Commission

THE domestic uranium industry, a vital part of the defense program and atomic power development, continued its rapid expansion during 1955, with continued major development anticipated for 1956. It is noteworthy that the economy of many areas, especially in the western United States, is greatly dependent on one or more phases of the uranium industry. One of the outstanding developments in 1955 was the high degree of participation of private industry in exploration, mining and processing as evidenced by the greatly extended geographical scope of the search for uranium and the record levels of both ore production and milling capacity.

Uranium ore production in the United States continued entirely within the control of private industry with the government providing such incentives as guaranteed minimum prices, various allowances, and an initial production bonus. It is estimated that approximately 6000 persons were engaged in uranium mining operations at the end of 1955. With the exception of the single Government-owned plant at Monticello, Utah, operated under a fixed-fee contract, all of the

processing mills were constructed and are owned and operated by private companies.

#### **New Mining Laws**

The enormous increase in prospecting and claim-staking, coupled with the rapid expansion of uranium mining has hastened the passage of considerable legislation affecting the public lands.

Public Law 167, 84th Congress, effective July 23, 1955, amended the general mining laws by barring future locations for common varieties of sand, stone, gravel, pumice, pumicite, cinders, and clay, and by prohibiting the use of any unpatented mining claim located thereafter for any purpose other than prospecting, mining, processing, and related activities.

Public Law 359, 84th Congress, approved on August 11, 1955, permits the mining, the development, and the utilization of the mineral resources of all public lands withdrawn or reserved for power development.

The exploitation of potentially important uranium-bearing lignites in North and South Dakota was being hindered by a conflict between mineral leasing laws affecting non-metallic minerals and the mining laws pertaining to the location of claims for metallic minerals. This situation was remedied by the passage of Public Law 357, 84th Congress, effective August 11, 1955, which permits the entry and location of mining claims upon discovery of a valuable source material occurring within lignites.

Several revisions of state mining laws were also recorded in 1955. The mining location laws of Wyoming were amended, effective February 11, 1955, to allow the performance of a certain amount of drilling in lieu of making a discovery cut, tunnel, or open cut. The Colorado mining law was amended as of April 8, 1955, to allow the filing of a map (containing specific data) attached to the location certificate in lieu of making a discovery shaft as formerly required. The laws of North Dakota were amended, effective March 10, 1955, to allow a drill hole, sufficiently deep to cut the lode, to be equivalent to a discovery shaft. South Dakota amended its mining law as of July 1, 1955, by eliminating the requirements for sinking a discovery shaft. These amendments to state laws, however, do not affect the requirements of the general mining laws for discovery of a mineral prior to location of mining claims.

#### Private Exploration Dominant

In 1955, reorientation of the Commission's exploration program to the development of basic geologic information and exploration techniques, the evaluation of private activities and discoveries, and the establishment and maintenance of current ore re-

serve figures and resource estimates, was completed. This was made possible by the expansion of private uranium exploration activity to the point where private enterprise has now assumed almost all of the burden of drilling, other physical exploration, and mine development.

The present form of the Commission's exploration program is required to provide the information upon which the Commission can base its production and manufacturing program and its long-range planning, and to assure advancement in geologic knowledge and exploration techniques which will provide the basis for the discovery of adequate uranium resources for the future.

The trend of domestic exploration seems to be one of comprehensive programs by larger companies. At least one petroleum company has initiated long-range geologic drilling for the purpose of obtaining fundamental geologic and stratigraphic information over broad areas that may provide the basis for important future discoveries. As the out-cropping and

near-surface ore bodies become exhausted, and new geologic information is gained, long-range programs of this type, in search of deeply hidden ore bodies will assume greater importance.

The success of past government drilling has been a contributing factor to the type of uranium exploration now undertaken by private industry which drilled in excess of 4,000,000 ft in 1955. As a sample of the emphasis private industry has put on drilling, more than 500,000 ft have been drilled in the Big Indian Wash area of Utah during the past year, with more than 30 drills operating during peak months.

With this expanded rate and wider distribution of private drilling in the western United States, the Commission is now concentrating on gathering and evaluating the data from this drilling and preparing maps and reports for use by private industry.

During 1955, private uranium exploration resulted in the development of new potential producing areas in Washington, North Dakota, South

ERIC R. RUDE has been associated with the Atomic Energy Commission since 1953. His technical training was received at the College of Mineral In-



dustries of Pennsylvania State University in geography and mineral economics. He taught geography in Greece for two years and was a graduate teaching assistant at Penn State for two years.

Dakota, Texas, Oregon, and Alaska. Other promising prospects have been found in California, Idaho, Montana, and Nevada. Intensive private activity was under way in the entire western half of the United States and some investigations were also carried out in the Appalachian area of the eastern United States and in Wisconsin, Michigan and Minnesota.

The major new discovery was in the Ambrosia Lake area, McKinley County, N. M. To date, wide-spaced driling in this area by several private companies has indicated reserves of several million tons of ore. Total reserves may prove to be much larger when more definitive drilling has been concluded. At present, exploration is being conducted on the basis of geological structure.

Other important additions to ore reserves were made as a result of further development in the Laguna Indian Reservation, New Mexico, Big Indian Wash-Lisbon Valley district, Utah, Red and White Canyon Region, Utah and other previously established uranium producing districts of the Colorado Plateau.

In some of the areas of recent interest such as Karnes and neighboring counties, Texas, The Wind River and Powder River Basins of Wyoming, and the Spokane Indian Reservation, Washington, indications are that ore reserves may be sufficient to support milling operations.

Uraniferous lignites of North and South Dakota and Montana may prove to be a significant source of uranium provided that economic processing methods can be developed.

#### **Expanded Mill Facilities**

United States uranium milling capacity was approximately doubled during 1955. With the new mills now under construction and planned, mill-



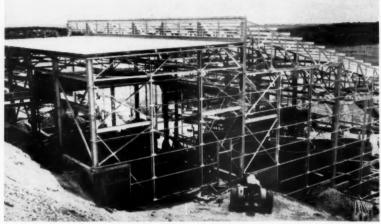
LOCATION OF PROCESSING MILLS AND ORE-BUYING STATIONS IN THE

ing capacity is expected to double again by the end of 1957. Ore production increased 43 percent over 1954 and was in excess of the tonnage milled. By the end of the year ore production and milling were about in balance. However, in 1956 ore production may increase faster than new mill facilities can be added so that the total quantity in stockpile may not be reduced until 1957.

Of the nine mills operating in 1955, major expansions took place at The Anaconda Co's. Bluewater, N. M., plant; the government-owned Monticello, Utah mill; the Climax Uranium Co's. Grand Junction, Colo., mill; Vanadium Corporation of America's Naturita, Colo., plant; and the Vitro Chemical Co's. Salt Lake, Utah mill.

The five additional processing mills for which contracts were signed in 1955 are now in various stages of construction. The Uranium Reduction Company is constructing a mill at Moab, Utah: Mines Development, Inc., at Edgemont, S. D.; Rare Metals Corporation of America, at Tuba City, Ariz.; Trace Elements Corporation, at Maybell, Colo.; and Continental Uranium Inc., at La Sal, Utah. A large expansion program is also under way at Uravan, Colo., by the Union Carbide Nuclear Company. It is expected that most of the new construction will be completed by the middle of 1956. Discussions and negotiations are also under way with other companies at this time for the construction of additional plants in a number of other localities on the Colorado Plateau. With the completion of the five new mills, the total number of operating plants will reach 14.

Three uranium recovery facilities are now producing and shipping small tonnages of uranium concentrates as a by-product of the recovery of phosphate chemicals and fertilizers from Florida phosphate rock. These fa-



Construction stage of \$2,000,000 uranium ore reduction plant at Monticello, Utah

cilities are Blockson Chemical Co., Joliet, Ill.; International Minerals and Chemical Corporation, Bartow, Fla.; and Virginia-Carolina Chemical Corporation, Nichols, Fla. A fourth facility, the U. S. Phosphoric Products, Division Tennessee Corp. plant at East Tampa, Fla., is presently under construction.

#### **New Ore-Buying Station**

The Commission established new ore-buying stations in 1955 at Riverton, Wyo., (March), and Cutter, Ariz., (July). The ore-buying station at Tuba City, Ariz., officially opened in January 1956. An additional buying station is contemplated for the vicinity of Grants, N. M., in the first half of 1956.

This will bring to 18 the number of mills and ore-buying stations throughout the western states where uranium producers may sell their ore. The American Smelting and Refining Company has been operating the A.E.C.

ore-buying stations under a fixed-fee contract since the beginning of the program. This company has asked to be relieved of this responsibility and a selection of a new contractor will be made shortly.

#### **New Mining Methods**

During the year the number of producing mines did not change materially from approximately 1000 producers, although production was increased greatly. This is best illustrated by the fact that prior to 1955 there were only about 10 deposits with reserves of 100,000 tons or more, while now there are about 25 such deposits, and a few with reserves measured in millions of tons.

The trend toward increased mechanization of uranium mines and deeper operations continues throughout the Colorado Plateau and outlying areas. Many old line companies have entered the industry and have brought with them the experience gained in other fields of mining.

In 1955 a three-compartment shaft was sunk by Hecla Mining Company in the Monticello mining district in San Juan County, Utah. Using a Riddell mucker, this shaft was sunk to a depth of almost 700 ft, and the monthly advance was approximately 300 ft.

A type of mining shaft new to the Colorado Plateau is the elliptical shaft being sunk by Beaver Mesa Uranium, Incorporated, in the Gateway mining district of Mesa County, Colo. This shaft, which will go to 320 ft, has concrete rings placed on six-ft centers with vertical two-in. lagging used between the one-ft concrete rings. Counterbalanced hoisting with a two-ton skip is planned.

A number of combined ventilation shafts and escapeways have been sunk by churn and rotary drilling methods. These shafts average around three ft in diameter and are lined by steel tubing. Steel ladderways and steel mesh



A uranium mining operation in New Mexico

landings are used. Longhole drilling continues to gain acceptance as an efficient method of exploration underground.

The Hidden Splendor Mining Company, Standard Uranium Corporation, and Utex Exploration Company are using Gismo self-loading transport equipment in their mining operations.

Anaconda's Jackpile mine in New Mexica, the Lucky Mc Uranium Corporation's mine in Wyoming, and Continental's Rattlesnake mine in Utah are examples of open-cut mining. Stripping at the Rattlesnake is done by means of tractor-scrapers, and four-yd shovels are used for loading the material into 15-yd dump trucks. The average length of the cut is 1200 ft.

#### **Process Development**

The development and improvement of processes for extracting uranium from ores has been largely the work of the Commission and its contractors. In the past this information has been classified and made available only to cleared personnel of milling companies and companies considering uranium milling. In 1955 uranium processing information was declassified. should not only simplify the problems for new companies interested in uranium operations but should also result in a more rapid development of the technology. A number of the methods developed for uranium recovery may be useful in other fields of metallurgy.

Much of the Commission's work on the development of processes for treatment of uranium ores has been carried on at the Raw Materials Development Laboratory, Winchester, Mass. The Grand Junction Pilot Plant using the laboratory data carries out the next stage of development. Both the Winchester Laboratory and the Grand Junction Pilot Plant are operated for the Commission by the National Lead Company under a fixed-fee contract. In addition to the development of new processes, the pilot plant is used to determine the adaptability of various types of ores to the processes used in uranium mills. This pilot plant has been an important factor in providing data on mill design, operating costs, and recoveries. It has speeded up the mill construction program by eliminating the necessity for each milling company to provide its own pilot plant.

#### **Foreign Operations**

Nineteen fifty-five was also a year of rapid progress in foreign uranium developments. Production increased as a result of the completion and operation of new uranium mills. Development and construction started at a number of new properties and exploration for uranium was active in many areas throughout the world.

In August, the Canadian government announced that March 31, 1956

would be the deadline for negotiating further special price contracts with private companies. To qualify for a contract, the contractors must present reasonable evidence that production will commence about April 1, 1957. Contracts will terminate March 31, 1962. Development of known Canadian uranium deposits is proceeding at an accelerated pace as a result of this announcement.

The outstanding developments in the entire foreign field were in the Blind River district of Ontario with activity centered on opening mines, constructing mills, and developing a field discovered in 1953.

Pronto Uranium Mines, in mid-October officially opened the first treatment plant in this area. Mine development and mill construction are presently under way at both the Nordic mine and Quirke Lake mine of Algom



Wagon drill used for exploration and development drilling in the West

Uranium Mines, Limited. Consolidated Denison Mines, Limited, has also begun construction on a large mill. Spanish-American Mines, Lake Nordic Uranium Mines, and Can-Met Exploration have indicated large ore reserves by extensive diamond drilling. By the end of 1956, this area should be mining and milling about 7000 tons a day. Ore reserves close to 100,000,000,000 tons have been indicated by diamond drilling.

Rapid expansion was also experienced in other areas. In the Beaverlodge area of northern Saskatchewan the Gunnar Mines, Limited, plant is now in operation and consideration is being given to construction of another plant to treat ores from Lorado Uranum Mines and other nearby properties. The Eldorado Mining and Refining Company, Limited, has announced plans to expand the capacity of its present mill in the Beaverlodge area.

In the Bancroft area of eastern Ontario construction of the Bicroft Uranium Mines plant is proceeding on schedule and sufficient reserves have been indicated by Faraday Uranium Mines, Limited to warrant production.

In South Africa the number of plants in operation for the recovery of by-product uranium from the gold producing areas of the Witwatersrand was increased to 13 with the addition of new plants by Welkom Gold Mining Company, Limited; Harmony Gold Mining Company, Limited; Harmony Gold Mining Company, Limited; and Virginia (O.F.S.) Gold Mining Company Limited. Three additional plants are nearing completion with full production from all facilities anticipated by the end of 1956.

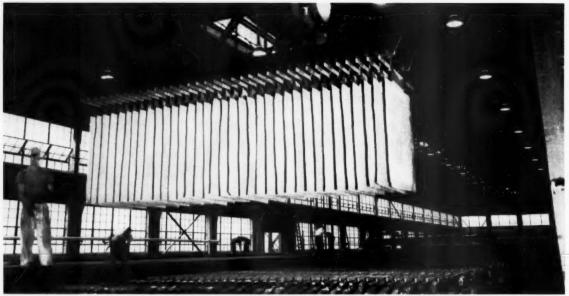
Widespread exploration by private interests continued in northern Australia. The Alligator River district in the Northern Territory and the The Alligator River district Mt. Isa-Cloncurry district in Queensland appear as potential producers. At present, consideration is being given to construction of a large mill at the Mary Kathleen deposit in the Mt. Isa-Cloncurry district. First shipments from the Rum Jungle ore processing plant arrived in the United States in the first half of 1955. Production of low-grade concentrates from the Radium Hill mine and treatment plant continued throughout 1955, with shipments being made to the Port Pirie chemical treatment plant, which began operating in mid-August.

The Belgian Congo, with the large new mill completed in 1954 operating at full capacity, was an important contributor to the uranium supply. The Urgeirica Mine in Portugal maintained normal operations.

The Commission has been cooperating with a number of foreign governments in conducting reconnaissance geological surveys and in developing uranium exploration programs. As a result of the increased interest in atomic energy development brought about by the Geneva conference, the Commission is now receiving additional requests for cooperation in the field of raw materials.

#### Prospects for 1956

Construction and development projects now under way in the United States and abroad assure a major increase in uranium production for 1956. Private exploration and development is expected to continue at an increasing rate, particularly in the United States and Canada, and new discoveries of importance may be made. With the continued rapid development of atomic power technology the outlook for a commercial market for uranium will be advanced and more information should be available for appraising the uranium requirements of the coming power industry.



300-lb cathodes about to leave the refinery

## Copper

High Demand, Strikes and Rising Price Characterize the Past Year in the Copper Industry

By HELENA M. MEYER

Assistant Chief
Branch of Base Metals
Bureau of Mines
United States Department of the Interior

THE anticipated relief from copper shortages in the United States did not materialize in 1955. Throughout the year, copper supplies were inadequate for consumption requirements; prices rose notably but failed to attain the high levels reached in other countries; and some of the usual sources of imported copper shipped smaller quantities of metal to the United States and greater quantities to more remunerative markets. To alleviate the short-supply situation, the Government permitted postponement of stockpile deliveries and sale of metal from Defense Production Act inventories, and banned or curtailed exports of domestic refined copper and copper and copper-alloy scrap.

#### Demand

The story of inadequate copper supplies in the United States and abroad stemmed partly from large world requirements but chiefly from serious work stoppages during the year in

several important copper-producing areas. On January 3 copper mining in Northern Rhodesia was virtually halted by a strike that continued until March 2. In the United States the properties of Calumet and Hecla, Inc. were closed from early May until late August. The most serious strikes began July 1 at many of the principal mines, smelters, and refineries of the nation, including the several divisions of the Kennecott Copper Corp., the mines and most of the plants of Phelps Dodge Corp., and a number of American Smelting & Refining Co. plants. These stoppages lasted from one to one and one-half months. In mid-December workers in Americanowned mines in Chile, regularly the second largest world producer but displaced by Northern Rhodesia in 1953 and 1954, went on strike reportedly in protest against provisions of the Labor Code in the new Chilean Copper Law. The strike remained unsettled at the year end. As a result of the foregoing strikes and of several



Once again we have called upon the very able HELENA M. MEYER to review copper in 1955. Miss Meyer's Government service began in the Geological Survey and since 1925 has been with the U. S. Bureau of Mines. She is author of numerous articles in the technical press and many commodities chapters of Minerals Yearbook. Currently she is the Bureau's commodity specialist for copper and mercury as well as assistant chief of the Base Metals Branch.

very brief ones, more than 150,000 tons of copper production was lost.

Despite these losses world mine production established a new peak in 1955 with approximately 3,300,000 tons as compared with 3,100,000 in 1954. The gain in 1955 resulted from increased production at going properties and newly-opened mines and came chiefly from the United States, Chile, and Canada. Northern Rhodesia would have established a fifth successive annual production peak except for the strike losses in January and February.

The large quantity of metal made available, however, could not fill the upsurging demand in the United States, the United Kingdom, West Germany, France, and other industrial nations, and prices were bid up to all-time peaks in the United Kingdom and to levels in the United States not approached in 90 years.

#### **Price Changes**

Thus, as in a number of recent years, prices were again very much in the limelight. Confusion brought on by dual, triple and even greater multiplicity of prices exceeded the situations that existed in past years. Prices on the London Metal Exchange were substantially in excess of those for most of the United States production throughout the year. It is noteworthy that a trend toward disposition of metal outside of the United States resulted. But all United States metal did not change hands at the levels of the principal producers and at times the price for custom metal approximated LME prices.

With the Rhodesian strikes a month old LME prices advanced to the equivalent of 40 cents a pound at the end of January and that for electrolytic copper delivered in the United States rose to 33 cents. In February the London price reached a new peak of £360 per long ton (45 cents a pound) and in late March rose to £367 (45.875 cents); principal United States producers raised

their prices to 36 cents in March; the LME price rose to 46.25 cents in July; principal United States producers raised quotations to 40 cents and then to 43 cents in August during the period of domestic strikes, and the LME price rose to £400 per long ton (50 cents a pound). The leading United States producers' price remained at 43 cents beyond the end of 1955; custom smelters' prices rose to 50 cents a pound in September, then fluctuated between that price and the principal producers' price until late in December when it increased to 50.25 cents. The LME price rose to an all-time peak of £405, equivalent to 50.625 cents, in mid-December, but dropped to 50 cents at the month end.

Meanwhile in May the Rhodesian Selection Trust Co. representing two of the four large producers in Northern Rhodesia, announced that effective May 9 it would offer copper at a fixed basic price of £280 a long ton (35 cents a pound), c.i.f. United Kingdom, to those of their consumers who were willing and able to instill a degree of stability into resale prices of copper and brass products. Prices were fixed for 30 days at which date they were to be fixed for another period. In May, on the other hand, LME prices rose to £334 (41.75 cents). In early September the RST price was raised to £360 (45 cents) and remained unchanged at the year end.

#### **Stockpile Diversions**

United States Government efforts to assist an industry harassed by shortages included release of Government holdings of metal and of metal under contract for delivery to the Government. Between October 16, 1954, and September 30, 1955, 31,100 tons was diverted from delivery to the stockpile, 6200 tons was diverted from delivery to Defense Production Act inventory, and 34,700 tons was sold from DPA inventory, or a total of 72,000 tons in about a year.

The United Kingdom Board of Trade took action similar to that in the United States by announcing in April the release of 45,000 long (50,000 short) tons of electrolytic copper to be sold during the remainder of 1955 and sale of 20,000 long (22,500 short) tons of blister copper to the Rhodesian Selection Trust group.

Inadequate supplies likewise led the United States Government to restrict exports. In February exports of refined copper of domestic origin were virtually banned and those of copper and copper-base scrap curtailed; in March copper and copper-base alloy wire and cable shipped elsewhere than Canada were made subject to licensing, and in the third quarter exports of foreign copper (formerly without quota) were limited to 54,000 tons.



Underground operations are still an important segment of the copper industry



Massive open pits account for the bulk of the world's copper production

#### **Production and Imports**

Despite strikes, mine output of copper in the United States rose to almost 1,000,000 tons in 1955, compared with 836,000 in 1954, and was influenced substantially by output from new mines that began to produce in 1953 and 1954. The best 1955 monthly rates for all States, if maintained for 12 months, would have totalled 1,200,000 tons. Only one large new mine—the San Manuel, Ariz.—started to produce in 1955 compared with four new ones in 1954. Two units of the San Manuel mill were put into operation in November.

According to estimates based on 10 months' receipts, imports of copper into the United States in 1955 probably dropped nearly five percent below the 590,000 tons in 1954, in turn 13 percent lower than 1953. The decline, despite the large United States demand, was due chiefly to the receipt of less than half as much refined copper from Chile in 1955 as in 1954 (126,000 tons) and resulted because prices favored foreign markets. Receipts of crude copper appeared to be about the same in 1955 as in 1954, or about 370,000 tons.

In June suspension of the excise tax on copper was extended for another three years, to June 30, 1958.

Exports, as already indicated, were restricted in 1955. Based on ten months' data, refined copper exports for the year probably were slightly less than 200,000 tons compared with 218,000 tons in 1954. Shipments of unalloyed scrap probably fell below 30,000 tons, compared with 76,000 tons, and of alloyed scrap were only half as large in 1955 as the 94,000 tons in 1954.

United States consumption of refined copper probably exceeded 1,450,000 tons in 1955 compared with 1,255,000 in 1954, or a gain of more than 15 percent. Availability of larger supplies would have resulted in greater consumption. Devastating floods in the Connecticut Valley, due to summer hurricanes, temporarily closed nearly one-third of the brassmill capacity of the country and were an added deterrent.

Refineries' year-end stocks of refined copper (20,000 tons) were the smallest in at least a half century, whereas producers' stocks of unrefined copper probably were unchanged from the 190,000 tons at the beginning of the year, and fabricators' inventories probably showed a small gain over the 361,000 tons on hand January 1.

#### Outlook

Copper invariably prospers when the level of industrial activity is high, and thus 1956 should provide continued large demand for this commodity, with a probable tapering of in the latter half of the year. Barr-



Newly completed townsite at White Pine, Mich.

ing major labor strikes, mine production in the United States will exceed that in 1955 by 10 percent or more, the import balance is likely to increase, over-all supplies may overtake demand before mid-year, and wide price variations doubtless will disappear or be greatly reduced.

basic conditions make it necessary for copper prices to favor competing materials to the extent they did in 1955.

If production stoppages are not serious in the future there is every reason to believe that copper's excellent qualities—electrical and heat conductivity, resistance to corrosion,



Mining and concentrating can be a large scale operation

The long-term expectation for copper is that there will be a large-scale and expanding consumption in the United States and elsewhere, that production will increase here and in all other major copper - producing. areas, and that supplies will be adequate to fill world requirements at current high and increasing rates of consumption for more than 25 years. Production capacity, doubtless, will be maintained in line with world needs. There are expected to be increased efforts to substitute aluminum and other materials for copper. This expectation is based more on recent fluctuations in supplies and prices, and fears that these conditions will recur, than on the belief that copper supplies cannot fill total needs or that

ductility, malleability and strength—will assure an increasingly important role in our expanding national economy,





Strip mining enjoyed the same comeback that the rest of the bituminous coal industry did

## Strip Mining in 1955

Year Saw Production Increase, Firmer Prices and the Construction of a 60-Yd Shovel

By S. F. SHERWOOD

President Stonefort Corp.

DURING 1955, the bituminous coal industry in general, as well as the stripping industry, experienced a pleasant increase in total production and a general firming of price. After several years of declining production and price structure this turn of events perhaps presages the beginning of the over-all substantial increase in annual bituminous coal production that has been forecast for the next decade by the statisticians and crystal ball gazers.

#### **Drilling and Shooting**

With an eye to this future increase in production, the strip mining industry in 1955 has seen further developments or innovations of new tools of production which will lead to relatively lower costs and increased production. Air blast rotary vertical drilling, introduced several years ago, is gaining wider acceptance. There are on the market a number of makes of such drills with varying capital cost and performance.

Along with the increased use of air blast rotary vertical drills, has come greater acceptance of the recently developed Akremite explosives (bulk ammonium nitrate mixed with a slight amount of carbon black) which is eminently suited for use in the large diameter holes made possible by the new vertical drills. This explosive is considerably cheaper than fixed explosives, and when applied under proper conditions, yields equal results.

#### **New Tamping Machine**

Another innovation in overburden preparation is the recent development in southern Indiana, of a machine to load and tamp horizontal holes. There has long been a need for such a machine, as the loading and tamping of 70, to 80-ft holes with up to 400 pounds of explosives, has been a time-consuming manual operation. This experimental machine, for which patent has been applied, has six-ft hinged tamping rods rolled from a



After service in the Navy during World War II. S. F. SHERWOOD went to work for the Central Indiana Coal Co. He advanced steadily, becoming general manager and then vice-president. After the merger of the Central Indiana Coal Co. and the Little John Coal Co. into the new Stonefort Corp., he became president. He is also president of the Sherwood-Templeton Coal Co.

reel and driven into the hole by the use of two rubber-covered friction wheels. Friction can be adjusted so that the proper amount of pressure can be applied to the tamping rod before slippage of the friction wheels on the rod occurs.

Experimental use of this machine indicates a considerable savings in labor costs, as well as much better compaction of explosives and stemming material, than is possible with manual means. Use of the loading and tamping machine should therefore mean better confinement of the force of explosives in the hole to effect a greater utilization of the explosive in breaking overburden.

#### First 60-Yd Shovel

The event most closely watched by the stripping industry in 1955 was the construction of the new Marion 5760 Shovel, at the Hanna Coal Co., St. Clairsville, Ohio. This machine has a 60-cu yd dipper with 140-ft boom. It carries a considerably larger dipper and longer reach than any previous stripping shovel available, and will permit the stripping of deeper coal with higher ratio than previously thought economically possible.

A machine of this size, of course, is feasible only on properties with extremely large reserves designed for large annual production. Many companies which already have stripping operations where fairly new stripping shovels are in operation, are investigating the acquisition of dippers made of high strength alloy steel to increase stripping capacity. These alloy steel dippers will permit about 20 percent increase in dipper capacity, with roughly the same over-all loaded weight of the dipper. With the reduced thickness, and the greater curvature of the lip in such dippers, the loading characteristics are improved over the standard dipper, though in all probability greater care must be taken in proper preparation of the overburden and in maintenance.

With the use of high strength alloy steel in shovel dippers, there is no reason to think that the next few years will not find its use expanding to other parts of the front end of the machine, thus decreasing the dead weight of the boom and permitting an even larger dipper or a longer dumping radius, enabling deeper overburden to be stripped economically.



Construction of the world's first 60-yd shovel was carried on in 1955. The machine, largest land-mounted piece of mobile equipment ever made in this country, moved from its construction site early this year

As yet, there is no equivalent development in dippers for large draglines. However, designing and experimentation is going on in the use of alloy steels in dragline buckets, five cu yd and up, undoubtedly, with design improvements in small buckets, these features will be carried upward into the design of large and lighter dragline buckets in the 35 to 45-cu yd class.

There is another development which would be desirable in large shovels. This would be the use of closely machined planetary reduction gears in the drive of large stripping shovel crawlers. There is considerable dead weight in the present type of large gear reduction train, and the down time of the stripping unit due to re-

placement of worn gears and bearings could be greatly reduced if a compact planetary reduction gear were developed to supplant the present ponderous chain of gears. Such planetary gears might cost more per pound of steel, but would probably cost no more over all, due to the considerable reduction in over-all weight, and repairs could be made in less time and with less labor because of the compactness of the unit.

#### Wheel Developments

Another stripping tool which has been around for years has recently been augmented and improved. There are now four large capacity wheel excavators operating in Illinois where overburden conditions permit their effective use. These machines are mounted on stripping shovel frames, but there the similarity ends. Instead of a dipper stick and bucket, there is mounted on a movable boom a large rotating wheel with a number of small buckets. This revolves and digs into the bank in a manner that reminds one of a small ditch digging wheel used to make trenches for pipes and cables. The material dug by the wheel is transferred to a series of belts which discharge the overburden over 200 ft from the machine by means of a stacking boom mounted on the opposite end of the machine from the digging wheel. The use of these machines has only been applicable where a large amount of the overburden consists of either top soil or relatively soft compacted material. The great advantage lies in the possible high yardage output for initial cost, and in the fact that the overburden is discharged well beyond the range of a shovel or dragline. Several refinements of design and operation have been made and applied in the past



Wheel excavators received added attention in areas amenable to their special diaging action



A machine to load and tamp horizontal drill holes mechanically was in use at one midwestern strip mine

year and it is reported that as a result of such changes, the modern wheel can be expected to have an output of 2000 cu yd per operation hour and an over-all efficiency of at least 75 percent.

#### Tractor Size Increased

Along with the increased capacity of stripping units has come major changes in the auxiliary workhorse of the industry - the tractor. In the larger sizes, all major tractor manufacturers now offer torque converters and have increased the size and horsepower of their units. One company has entered the field with a novel twoengine split frame unit which has not had time to see acceptance in the stripping industry.

With the advent of tractors in larger sizes and power, the possible use of these large units as an auxiliary stripping unit in mines using large draglines might well be explored. It is customary in dragline work for the machine to dig down 5 to 15 ft through top soil and clay in making the level bench on which it works. This benching work of the dragline, done by the machine itself, results in inefficient digging action and cycle time. With the introduction of tractors with greater horsepower and large blades, the economics of having these large tractors push the first 5 to 15 ft of overburden directly into the pit and creating the dragline's working bench needs to be explored. This would permit the dragline to concentrate on work for which it was designed. The use of the tractor for benching purposes would thereare doing it, digging in an inefficient manner. Haulage

much more cost than large draglines

There has not been any great change in truck design this past year, though there is continued experimentation in the use of high strength alloy to reduce the dead weight of the units.

Probably the most radical experimentation of haulage has been the installation of a belt conveyor system in a southern Illinois strip mine. Coal is transported from the mouth of the pit to a storage pile at the preparation plant. From a direct operating cost standpoint, this has proved highly successful. The initial investment in the belt is, of course, many times higher than the installation of truck roads, but the belt conveyor components can be used again and again, from location to location, whereas truck roads must be abandoned as the pit locations change. Also, because the haul from the loading shovel from the mouth of the pit is always short, much of the investment that is put in the conveyor is saved by not having to buy as many haulage units. The ultimate proof of the advantage of belt haulage, however, will have to remain undecided until experience shows the actual working life of idlers and belting.

by increase the over-all pit yardage considerably. These large tractors might very well be able to shove dirt and clay over the high wall at not



Air blast rotary drilling gained wider acceptance



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That was the day you thought the job was going to move out ahead of schedule. But the clutches were getting hotter all the time. By mid-morning the dragline went down for clutch adjustment—the heat had done it. After the noon break, the same thing happened. How much production do you figure you were penalized for having a rig with old-fashioned clutches?

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#### LINK-BELT SPEEDER

Builders of a complete line of crawler and rubber-tired shovel-cranes.



The Bunker Hill smelter

### Lead

#### 1955, a Year of Intensified Activity: The Outlook for 1956, Optimistic

By WALLACE G. WOOLF

General Manager Bunker Hill and Sullivan Mining and Concentrating Co.

WITH over-all trade and industrial activity in the United States enjoying. during the year 1955, what even staid economists term boom conditions, how did the lead industry segment of the general economy fare?

The accompanying table, repeated in similar form to a previous yearly review, gives the essential basic data in

summary. As can be seen from the table, the estimated total consumption at around 1,192,000 tons was the largest in recent years and approximately nine percent above the previous year's tonnage. This increase in consumption of 1955 over 1954 was just about the same as the decreased consumption of 1954 as compared to 1953. Lead, be-

119,000

199 000

90,000

46,000

155,000

1 192 000

 $^{+26.5}_{-14.4}$ 

+11.7

+ 8.9



After varied experience in milling and metallurgy, W. G. WOOLF joined Bunker Hill and Sullivan Mining and Concentrating Co. in 1918 as a research metallurgist to do work on the complex zinclead ores of The Coeur d'Alenes. He worked on differential flotation and an electrolytic zinc process for the resulting zinc concentrates. This work resulted in the building of the Sullivan Mining Company's zinc plant in 1928. He was superintendent of the plant until 1955 when he was made manager of metallurgy for Bunker Hill and Sullivan at the time the zinc plant was brought more closely into Bunker Hill's management. He is now general manager of Bunker Hill and Sullivan Mining and Concentrating Co.

#### ESTIMATED COMPARISON DOMESTIC LEAD SITUATION, 1954-1955 Lead 1955 (Tons) Per Cent Change Consumption + 8.91,192,000 Supply Mine Production 333,000 Imports Secondary Production 485,000 1.220,000 - 1.7 28,000 Consumption by Industries Tetra-ethyl Lead 161,000 $^{+}_{-}$ $^{,3}_{-}$ $^{+}$ $^{9.1}_{-}$ $^{-}$ Storage Batteries Cable Covering 368,000

Above consumption figures do not include Government purchases of lead for stockpile. After taking these acquisitions into consideration the 28,000 ton surplus becomes deficit.

a deficit. November, December figures and year-end adjustments estimated.

Total

ing a basic commodity, thus in general continued to follow the trend of the national economy. Although the table, without consideration of government purchases for the government stockpile indicates a supply in excess of consumption, there was in reality a deficit when those purchases are taken into consideration even though in the last quarter of the year little lead was offered to the government because of heavy industrial demand. The year ended with substantial reduction of stocks in the hands of both producers and consumers. Domestic demand for lead continued large as the year ended with some producers having an unsatisfied consumer order list.

Construction

Ammunition

All other uses

Pigments

Solder



Pouring molten lead

#### **Price Changes**

Pricewise, lead ended the year at 16 cents, New York, having advanced a half cent a pound on December 29, which was the first advance since September 23 when it was increased a half cent per pound to 15½ cents. The previous quotation of 15 cents had held since October 4, 1954. Lead had not been quoted as high as 16 cents since October 6, 1952.

At the time this article is submitted, the lead price has been increased to 161/2 cents on January 4, 1956. These recent higher quotations were made to match the European market; consumers there not having been able to get all the lead they needed from their regular producer sources and consequently resorted to purchases on the London Metal Exchange which resulted in a steadily rising price trend there over the last several weeks of 1955 and continuing into the first week of 1956. As previously mentioned, there was likewise a tightening lead supply situation domestically bolstered by heavy industrial demand and intensified by decreased output resulting from strikes that closed important processing plants in this country for a period during the summer and some Coeur d'Alene district mines later in the year that are still closed down. Also, output from certain Mexican smelters was reduced for a period during the year as a result of storms which interfered with delivery of necessary operating supplies.

1955 did not see any material increase in domestic mine production. No important new sources came into production and the supply came from established producers. In this regard, it still remains the belief of the domestic mining industry, as expressed during the year by a number of leading spokesmen and resolutions of mining organizations, that an increased tariff

is necessary if "a strong, vigorous and efficient mining industry essential to the long-term economic development of the United States" is to be realized as recognized by the President's Cabinet Committee on Mineral Policy. The recommendations by the delegates to The Western Governors Mineral Policies Conference in Sacramento, California, November 7 and 8, were an excise tax of 2.5 cents per pound on imports of lead be imposed to take effect whenever the price of lead should fall to 16 cents, New York. They also recommended that the present stockpiling of lead (and zinc) be continued until such time as the tariff recommendations are put into effect.

#### New Sources Required

Several leading spokesmen for the mining industry have pointed out during the past year that the sustained

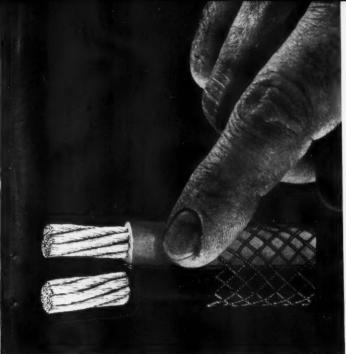
increased European industrial activity with its accompanying higher standards of living is requiring larger tonnages of metal among which, of course, is lead. They point out that the long-term trend, therefore, may very well see a modification of the past pattern of metal distribution internationally. This would be intensified if and when the underdeveloped nations of the world improve their economy, which seems likely. sustained economic growth of this country will also increase its requirements. Emphasis should again be made to the fact that since World War II the United States has had to resort to imports of lead to obtain its requirements; it is no longer self-suffi-If, then, these combined industrial expansions eventuate, there can be only one answer-more mines must be brought into production to supply the increased demands. And to keep pace with industrial growth in the United States and to insure an effective mobilization base, new lead production must be found in this country.

The inter-play of world-wide supply and demand with its concomitant price variations often becomes complex and is an abstruse and baffling enigma. Somehow with rare exceptions requirements have been satisfied in the past, and it is hoped they will be in the future. Abrupt price variations are worrisome to consumers and are also disliked by producers. The lead industry has also to look to its present markets; too high a price for lead in relation to the Commodity Index encourages the encroachment of substitutes and discourages the development of new uses.

For 1956, surveys reflect a distinct tone of optimism for national income, industrial production and construction. With this prospect the lead industry has every expectation of a good year.



"... and you know what they call him?—'Little Joe!' "



New neoprene insulation compound gives Securityflex cable physical toughness on the INSIDE as well as the outside...resistance to puncture, flame and crushing.



New flat stranding of grounding conductor prevents broken wires – thus assuring continuity of operation. Full 50% wire gives peak electrical protection.

## New Triple Protection

#### shuttle car cable

Before designing the new Securityflex\* cable, Anaconda engineers checked thousands of shuttle car cables of all makes to see why they failed.

They found the jacket often looked fine, but constant bending, flexing or excess tension had broken insulation or snapped conductors. To combat cable "heart failure"—Anaconda's new Securityflex cable provides *triple protection inside* to match tough outer strength.

#### 3 New Advantages

- 1. Rugged high-grade neoprene insulation greatly increases resistance to puncture, flame and crushing.
- 2. Improved stranding of ground and power conductors prevents broken wires—assures continuity of ground.
- Nylon breaker strip increases short circuit protection. Nylon jacket reinforcement also adds to cable strength and prevents wicking of moisture.

#### Full 50% Grounding Wire

In addition—full, 50% grounding wire insures greater electrical protection, longer life, and extra safeguard against excess tension. Anaconda's flat, service-proven grounding wire allows more cable on reel—will not cut insulation if cable is crushed by runovers. Millions of feet of new Security-flex have been sold without a reported failure of grounding conductor. Insist on full-size grounding conductor for safety.

Ask the Man from Anaconda or your distributor for details. Anaconda Wire & Cable Company, 25 Broadway, New York 4, N. Y.



New nylon Anti-Short Breaker Strip\* gives Securityflex amazing crush resistance... minimizes short circuits between conductors even under heavy impact.

ASK YOUR ANACONDA® DISTRIBUTOR FOR MINE CABLE



View of cell room, electrolytic zinc plant, American Zinc, Lead & Smelting Co., Monsanto, Ill.

## The Zinc Industry in 1955

Bright Prospects Follow a Year of Record Activity

FOR the American zinc industry, as for business generally, 1955 was a year of record activity. In both the production and the consumption of slab zinc, new all-time highs were reached in response to the strong demand for metal by the industry, supplemented by government purchases for the stockpile.

Smelter output, totalling an estimated 1,025,000 tons, exceeded the 1,000,000 tons for the first year in history (the previous high of 971,873 tons attained in 1943 during World War II). At the end of the year production was continuing at record levels and increases of output in several locations are indicated in 1956. Barring unforeseen disturbances, due to strikes, power shortages, or a national emergency, production in 1956 will again exceed the 1,000,000-ton mark.

#### **Record Demand**

The demand for slab zinc, of all grades, was exceedingly strong throughout the year and difficulty was encountered at times in meeting the requirements for special high grade slab zinc. The total slab zinc consumption during the year is estimated at approximately 1,075,000 tons, the highest on record. This high

#### By HOWARD LEE YOUNG

Vice-President
American Zinc, Lead & Smelting Co.

rate of consumption was made possible by record domestic smelter output, the drawing down of surplus stocks accumulated by smelters, by imports which continue to come into the United States at a high rate and by continued purchases for the government stockpiling program.

The record rate of automotive production at approximately 8,000,000 cars during 1955 and the substantial increases in zinc per car made for an extremely tight position in the die-casting grade of slab zinc during the last half of the year. By the end of the year the stocks of this grade zinc in the hands of producers were at a dangerously low point. Reliable estimates of automotive production, while somewhat less than the record of 1955, still indicate good demand for slab zinc for this important industry in 1956. (estimated automotive production at 6.5 to 7.0 million cars). Use of zinc per car is increased about 10 to 15 percent on 1956 models.

A striking feature of 1955 slab zinc consumption was the sharp increase of special high grade for die castings. Although data for the full year is not yet available, consumption by die casters appears to have totalled some 390,000 tons, breaking all previous records by a wide margin. The



HOWARD LEE YOUNG joined the American Zinc Sales Co. in 1937 in sales and advertising. He was appointed central district manager in 1941. In 1950 he became manager of metal and acid sales, and in 1954 was elected vice-president of American Zinc Sales Co. and American Zinc Oxide Co. Last year Mr. Young was elected vice-president of American Zinc. Lead & Smelting Co., in charge of the company's sales activities.

#### CONSUMPTION OF SLAB ZINC

|                         | 1954      |      | 1955      | •    |
|-------------------------|-----------|------|-----------|------|
| Galvanizing             | 398,599 1 | Tons | 445,000   | Tons |
| Brass & Bronze Products | 107,293 7 | Cons | 145,000   | Tons |
| Zinc Base Alloys        | 286,817 T | Cons | 395,000   | Tons |
| Rolled Zinc             | 45,979 T  | Cons | 52,000    | Tons |
| Zinc Oxide              | 18,176 7  | Cons | 22,000    | Tons |
| Other                   | 15,166 7  | Cons | 16,000    | Tons |
| Total                   | 872.030 T | Cons | 1.075,000 | Tons |

\* Based on Bureau of Mines figures for October 1955. Last two months estimated at present

high rate of automotive production and the increased use by this industry of zinc-base die-castings, accounted for an estimated 70 to 75 percent of the entire consumption of zinc base die-castings.

The price of special high grade zinc was on a favorable competitive basis with other metals used in die castings and this was an important factor in promoting its use on a much larger scale. During some months of the year the consumption of zinc for die-castings approximately equalled that for galvanizing, the largest zinc use, for the first time in history.

Consumption of slab zinc for galvanizing totalled over 364,000 tons during the first ten months of 1955, and will probably amount to some 440,000 tons for the entire year, equalling the record year of 1950, when the all-time record was sent with 441,686 tons.

Consumption of zinc in the brass industry showed a substantial increase over 1954, and use in rolled zinc products, zinc oxide, and other outlets was on a very satisfactory level.

It should be noted that approximately 90,000 tons of slab zine was shipped to the government stockpile under the continuing buying program of this Agency, and this factor was largely responsible for the reduction of stocks in the hands of producers. Present indications are that this program will continue, at least during the first half of 1956, so that with good demand from consuming industries the domestic smelters will continue to ship their entire production during the first half of 1956.

#### Mine Production Up

The record demand for slab zinc resulted in some improvement in domestic mine output in 1955.

This production increased moderately in response to the gradual increase in zinc prices to 505,000 tons of recoverable metal, which was some 40,000 tons above 1954. However, most marginal mines, which were closed in 1953 and 1954, due to the sharp drop in zinc prices, were still unable to resume profitable operation at prices which prevailed during the forepart of 1955. Present domestic mine production is equal to about

| U.   | - | S | 6 | 5] | A | I | 3 | - | Z | I | N | 1 | 3 | P | I | 1 | 0 | DUCTION       |
|------|---|---|---|----|---|---|---|---|---|---|---|---|---|---|---|---|---|---------------|
| 1954 |   |   |   | ,  |   |   |   |   |   | + |   |   |   |   |   |   | × | 868,242 Ton   |
| 1955 |   |   |   |    |   |   |   |   |   |   |   |   |   | 0 |   |   |   | 1,025,000 Ton |

40 percent of the ore required for slab zinc and zinc oxide production, whereas, during the earlier post-war period domestic mine output, which was at a much higher rate, was equal to about two-thirds of the domestic requirements for slab zinc and zinc oxide production.

#### **Increased Imports**

Foreign consumption of slab zinc improved during the year, but zinc imports in the United States during 1955 continued at a very high rate. Total imports of zinc ore (metal content) for the first ten months of the year amounted to nearly 400,000 tons, over 30,000 tons more than the like period of 1954.

Imports of slab zinc for the same period totalled 157,101 tons, and probably will approach 200,000 tons for the entire year, representing an increase of some 40,000 tons over 1954. Imports of both ore and slab zinc reached the highest level of the year during September and October despite higher prices on the continent. For these two months the imports of ore totalled 103,152 tons (metal content) which was at an annual rate of over 600,000 tons, an all-time high, while slab zinc imports, totalling 40,142 tons, were at an annual rate of over 240,000 tons. Exports of slab zinc in 1955 continued at a very low level, totalling only 18,813 tons for the first eleven months.

#### **Prices and Inventory**

Relative stability featured the price picture on slab zinc during 1955. The price of prime western at the beginning of the year was 11-½ cents per pound, f.o.b. East St. Louis, Illinois basis, and advanced during the year in an orderly fashion to 13 cents on September 6, continuing at this level to the end of the year. On January 6, 1956, the price of prime western slab zinc was advanced to 13-½ cents per pound. This increase was brought about by considerably higher quotations in the

foreign market and by continued strong demand in domestic industry.

The premium for special high grade slab zinc was at 1-½ cents per pound over prime western until October 20, when a leading producer raised the premium to 1-¾ cents, due to higher costs and increased freight rates. Gradually, other members of the industry followed suit until by December 1 the premium was established at 1-¾ cents.

Stocks of slab zinc at smelters were reduced from 124,277 tons on January 1 to approximately 35,000 tons at the end of the year, decidedly below what may be considered a normal stock. Consumers' stocks increased somewhat during the year by approximately 10,000 tons due in part to the high rate of consumption and necessity for higher working inventories. The present stocks of approximately 110,000 tons in the hands of consumers is considered adequate.

#### Prospects Excellent

Prospects for continued good business in zinc during 1956 appear to be excellent. With a favorable price position compared to competitive metals, zinc consumption in die-castings should hold its own, or perhaps show an increase during the year. The demand for galvanized products is strong and promises to continue. This same situation is true in the brass industry.

Additional smelter production of special high grade is scheduled for late 1956 and 1957. New mining properties which will begin production in 1956 will more than offset those facilities which may be curtailed.

The end of 1955 finds the zinc industry in a far stronger position than was true at the beginning and future prospects are bright.



(Photo by courtesy of U. S. Bureau Mines)
The zinc industry continually introduces improved mining methods and
equipment



## Headed Bolt with Expansion Shell Helps Promote Mine Safety



Your mine becomes a safer place in which to work, with severe roof falls unlikely, when you adopt roof-bolting, using Bethlehem's square-head roof bolt. This method of roof support anchors overlying rock, keeping it firmly in place. Roof-bolting, installed quickly and at moderate cost, has other advantages, too. Ventilation is improved, due to the absence of old-fashioned, bulky supports. There's less need for storage space, both above and below ground. And production is increased, because there's more clear space in which to operate mechanized equipment.

#### **Made in Three Types**

The Bethlehem square-head roof bolt is made in three types: (1) ¾-in. diam carbon steel, with minimum breaking load

of 20,000 lb; (2)  $\frac{5}{8}$ -in. diam high-strength, with minimum breaking load of 20,000 lb; and (3)  $\frac{7}{8}$ -in. diam high-strength, with minimum breaking load of 40,000 lb.

All three types are used in conjunction with a leaf-type malleable-iron shell, which expands when tightened, locking the assembly in the hole. A square roof-plate provides added support. A hardened washer, furnished with the assembly, reduces friction between the bolt head and the roof-plate.

The best way to get started on a roofbolting program is to talk things over with a Bethlehem representative. He'll be pleased to call at your convenience. Just get in touch with our nearest sales office.

#### **Slotted Roof Bolts**



In addition to the headed bolt, Bethlehem makes a 1-in. diam slotted roof bolt, for use where maximum strength is desired. The bolt is also suitable for pillar bolting. It is furnished with a 6-in. forged slot, and comes with a steel wedge which spreads the slotted portion when the bolt is driven. Bolt has truncated-cone point to prevent thread damage. It is normally furnished with American Standard regular square nut.

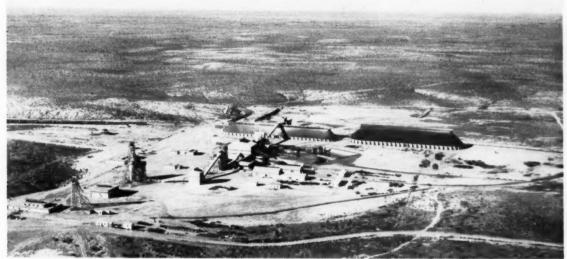
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Southwest Potash Corp. plant at Carlsbad

## Potash in 1955

Another Record Production Year in the Potash Industry Features Continued Expansion and Many Methods Improvements

#### By FREDERICK H. STEWART

Manager of Mining and Exploration Dept. The American Metal Co., Ltd.

ALTHOUGH final figures are not yet available, it seems certain that the mining and refining of potash in the United States set a new record in 1955. Deliveries of potash by American producers and importers for the nine months through September 1955, according to the American Potash Institute, were 7 percent higher than for the corresponding period of 1954. If this same relationship to the previous year holds for the final quarter, as expected, deliveries for the calendar year should approximate 2,304,000 tons K<sub>z</sub>O, a new record high.

With almost 90 percent of American potash going into agricultural fertilizer, deliveries for agricultural purposes to the U. S., Canada, Cuba, Puerto Rico and Hawaii advanced 2 percent for the first three-quarters of 1955 above the first nine months of 1954. This is a lower percentage increase than for chemical uses and export. Again assuming that this relationship holds for the final quarter,

deliveries for agriculture in 1955 should be about 1,871,500 tons of  $K_2O$ . This was achieved in spite of the estimated 2 percent decline in over-all fertilizer deliveries which was attributable to a combination of lower farm prices, reduced farm income, crop restrictions and efforts to dispose of farm surpluses.

#### Deposits in Canada

The Department of Agriculture in discussing the 1955-56 outlook for fertilizer has estimated that the supply of potash available for fertilizer will be 1,940,000 tons of  $K_2O$ . This is based on existing rates of production and trends in usage and foreign trade rather than on capacity, which on July 1,1955, was estimated at 2,100,000 tons of  $K_2O$  and was increasing as the industry planned 400,000 tons additional potash capacity for early completion.

Interest in Canada's potash deposits increased greatly in 1955, and



FREDERICK H. STEWART was recently appointed manager of the mining and exploration department of the American Metal Co., Ltd. He has had a wide background in mining and geological work including five years in Bolivia as a geologist for the world's largest tin mine. He was also in the gold camps in the Philippines and later in Pachuca, Mexico, as a geologist for a large silver property. In 1941 Mr. Stewart became associated with the American Metal Co., Ltd., as a geologist. Later he was placed in charge of all western exploration which developed the company's potash ore deposits, and was made vice - president and general manager of Southwest Potash Corp., a subsidiary of American Metal.

all major American potash mine producers have acquired holdings there. Eleven companies have applied for permits and withdrawals in Saskatchewan, and the land thus taken up forms a continuous strip 15 to 40 miles wide and 375 miles long. Large production in Canada would seriously affect the American industry.

The American potash industry is centered at Carlsbad, N. M., where 11 million tons of ore were mined and milled in 1955. The five produc-

ing Carlsbad potash companies had a very active year in production and made many improvements in their mines and refineries. Announced additional capital investments, in new plants or expansion, total approximately \$35,000,000.

#### New Companies Develop

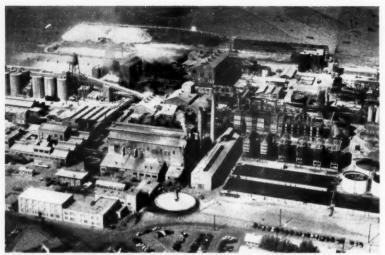
National Potash Co. will be the sixth producer in the Carlsbad area. National is owned jointly by Freeport Sulphur and Pittsburgh Consolidated Coal Co. The company has potash leases covering 15,000 acres in Lea and Eddy counties, N. M. At an estimated capital cost of \$16,000,000, a mine and refinery are being built. Completion date of these facilities is set for the first quarter of 1957 when limited production is to start. Plant capacity is to be 4000 to 4500 tpd.

The sinking of two shafts started in April 1955. The shafts are 15 ft inside diameter, concrete lined and are to be sunk to a depth of about 1750 ft. The Bain method of sinking is being used. To date the shafts are sunk to a depth of 600 ft with a connecting tunnel at the 500-ft level being driven. An 8½-mile extension of the Santa Fe Railway has been laid to service the operation. A 22mile water pipeline has been laid, and wells have been equipped to the extent that water for construction purposes is available. Access roads have been completed. Construction of surface facilities started in October 1955. An office building is about completed. Warehouse and shop facilities are being built along with various utility service lines. Various other grading and foundation work is in progress. Stearns-Roger is the prime contractor for the surface facilities, and Mc-Kenzie-Whittle is the shaft contractor.

National Farmer's Union recently merged with Kerr-McGee Oil Industies, Inc., and Phillips Chemical Corp. to form Farm Chemical Resources Development Corp. for developing and operating a seventh potash property in the Carlsbad Potash Basin. The shaft site has been selected and the preliminary work of coring the salt overburden and testing for water has been completed, and coring of the salt through the 10-in. cable tool hole is under way. It is planned to submit the first shaft for bid in the near future. The first shaft will be a man and material shaft, although some ore will be hoisted from this shaft for operating a pilot plant which will be in operation while the second shaft is being sunk and the mill constructed. Reported plans are to have the property in operation in 1959.

#### **Growth and Expansion**

United States Potash Co., pioneer in New Mexico, is modernizing its refining facilities and expanding production by approximately 20 percent at a cost of some \$3,000,000. In order



American Po'ash & Chemical Corp.'s main plant at Trona, Calif., covers 45-acres and produces more than 20 chemicals out of dense brine pumped from beneath surface of nearby dry Searles Lake

for the mine to produce the additional tonnage required by the refinery expansion, a loading pocket and a complete crushing and loading plant were installed at the company's No. 2 shaft. New type Joy continuous miners, designed for potash use, were put into service with 36-in. underground belt haulage that loads to existing underground rail transportation by Stamer automatic car moving and loading equipment.

A third 70-ton diesel electric locomotive and twenty 40-ton capacity narrow-gauge cars were purchased in order to haul the additional tonnage the 16 miles from the mine to

the refinery.

Potash Company of America has moved ahead satisfactorily in its Canadian project, Potash Company of America, Ltd., with construction of buildings and headframe well under way near Saskatoon, Saskatchewan. Shaft-sinking operations were scheduled to start shortly after the first of this year,

In the Carlsbad basin, PCA's \$3,000,000 mine and plant modernization program, announced in last year's Mining Congress Journal review, is progressing with three new PCA Model 200 continuous miners now in operation and four more under construction. Like the earlier Model 150's, they have indicated excellent performance. When all these machines are working it is expected that approximately 80 percent of PCA's tonnage will come from continuous miners, including four Joy machines.

Installation was begun of an extensive belt system which, when completed, will have a total length of more than seven miles. It is said to be the longest underground belt system in the United States. A 2800-ton capacity underground ore bin serves



Sinking headframes at National Potash Co.

the belt system which reduces lag time during shift changes.

#### Efficiency Improvements

Production by International Minerals & Chemical Corp. continued in 1955 the upward curve which it has followed since operations were started in 1940. This was accomplished more through a general improvement of efficiency than by any major expansion project. In the mine, holes per man were improved by remodeling Joy jumbo drills so one operator handles controls for both booms from a console mounted in the center of the machine. Design for the remodeling was done by local engineers. Magnetic brake cars have been put into service wherever loads are to be moved down grades. This has improved the safety factor and, in some cases, released motors for other haulage.

A Stammler-Edmonds car-spotter has improved efficiency in handling mine cars under transfer elevators and is controlled by the shuttlecar operator. Tests with the new doublelength dynamite sticks have indicated more efficient breakage with a saving in powder, and warrant further tests. To handle increased tonnage from underground, capacity of ore skips has been enlarged 20 percent, and the processing plants handle this tonnage with only minor equipment adjustments.

Outstanding processing development during the year was the changeover to production of 60 percent granular with the old 50 percent product being discontinued. granular muriate is produced by flotation. Capacity of the potassium sulphate section was increased during the year by addition and enlargement of equipment to take care of expected sales demands. Production of hydrochloric acid and magnesium oxide, which are recovered from waste liquors, was increased.

Work is approximately 25 percent finished on a new office building at the mine site which will house all staff offices and get all administrative con-

trol under one roof.

Duval Sulphur & Potash Co. had routine operations in 1955, but noted a small increase in production through improved practices that resulted in higher extraction and fewer delays in operations. New construction was limited to that required to maintain production.

October of 1955 marked a full year of operation for a new screening unit wherein a coarse fraction of the 60 percent muriate is screened out for the granular trade. This section, which employs Tyler Hummer screens, has given highly satisfactory results from an operating standpoint and the product has been well accepted by the trade.

The mine belt-haulage system was



Underground conveyor system of the Duval Sulphur & Potash Co., Carlsbad

extended 2400 ft during the year in keeping pace with the advancement of production areas. A panel belt 600 ft long was installed to facilitate panel development and to reduce the distance of shuttle car haulage. A rubber-tired dozermobile driven by diesel power has proved to be a valuable addition to the mine equipment.

#### Progress at S. W. Potash

Southwest Potash Corp. completed an efficient main line track haulage system underground. Essential features contributing to the safety, efficiency and speed of the modern haulage system are M.S.A. minephones, automatic track and derail switches, and a simple but efficient electric block signal system. The M.S.A. minephones utilize the trolley as a carrier, and all locomotives and track jeeps are equipped with them. This provides constant communication between the operators of all mobile track equipment and contributes to safe and rapid movement with minimum delay. All track and derail switches on the haulage main lines are automatically operated with Cheatham electric switch throws, which are energized through a trolley contact switch. The electric block signal system includes red and green signal lights located at 2000-ft intervals on straight tracks and at all turnout points.

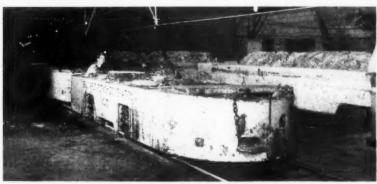
A Joy Universal cutting machine (15RU) was recently placed in op-

eration. This machine was designed on the basis of developments in the Carlsbad Potash Basin and the performance of the 10RU. The 15RU is a heavy, rugged machine, having adequate power and good maneuverability and has advantage over the short wall type cutters. These advantages include faster cutting, closer control of cutting to the ore, and one-man operation. It also can be used for cutting cable trenches and shearing walls and trimming.

The company recently began a major construction program, costing approximately \$2,500,000, to modify the existing mill and to expand milling capacity by one-third. The Plant, which began operations in August 1952, was designed for an initial capacity of 3000 tons of ore per day. The modification program will include a high degree of automation in the mill and incorporation of better processing techniques which have been under development since the operation began.

Operations by American Potash & Chemical Corp. at Trona, Calif., continued normal through the year with no important changes in operations or production.

Bonneville, Ltd., Windover, Utah, reported that operations continued through 1955 up to September 28 without change at their normal production rate. However, production was interrupted on September 28 by a strike which at the end of the year was still in progress.



Ma'n line locomotive



Surface plant of the Lynnville Coal Co. A modern layout with 38 acres of grass. In the foreground is the 55-acre refuse lake where all 4-in, by 0 waste material is pumped

## **Coal Preparation**

## Continued Progress in Coal Cleaning Techniques Marks Year

By A. P. MASSMANN

Preparation Manager Sinclair Coal Co.

COAL PREPARATION advanced in many ways during 1955. This advancement was greatly stimulated by the increased demand for coal from utilities, steel plants, and industry as a whole. Appreciation for preparation's progress should be given to all of those who have contributed in any way to the improvements and advancements which are available to all of us for our advantage today. The contributors are many. They include the tipple foreman or top boss who comes up with ideas for quality improvement or cost reduction in a plant function; the laboratory technician who by his daily checks and tests plots and records the results achieved; the preparation engineer analyzing daily reports and always striving for the ultimate in quality, recovery, and reduction of costs; the college professors and U. S. Bureau of Mines personnel who conduct exhaustive tests on small scale and full scale equipment to evaluate the abilities of new and old machines which are available for preparation functions; and last, but not least, the manufacturers who are willing to undertake an idea or machine and risk their capital to perfect a new piece of preparation equipment.

In 1955, the preparation engineer had many fine pieces of equipment at his disposal to choose from in designing a modern fuel factory to yield both an acceptable product and a profit. Let us review briefly what was evolved and put to work during the year.

#### Sampling

With an ever larger percentage of our coal production going to utilities on a guaranteed basis, accurate sampling at the preparation plant and at the power plant is becoming more and more important. The payment for the coal sold in this manner is determined by the sampling results. One new type of automatic sampler was put in serv-



Experience as a coal preparation equipment salesman and as a coal preparation engineer particularly qualifies A. P. MASSMANN to prepare the review of progress in coal preparation during 1955. After working 10 years for the McNally-Pittsburg Manufacturing Corp.. Mr. Massmann joined Sinclair Coal Co. in 1946 as preparation engineer.

ice in early 1955 by a dock corporation on the Ohio River. This sampler, automatically timed, makes a cut across the full width of the product once each eight minutes. The results from the new sampler check within proper limits the results taken from another type sampler which takes a cut of all material delivered at destination every 10 minutes. The new sampler was developed and is built by McNally-Pittsburg Manufacturing Corp. of Pittsburg, Kan. It has been utilized to sample raw products other than coal.

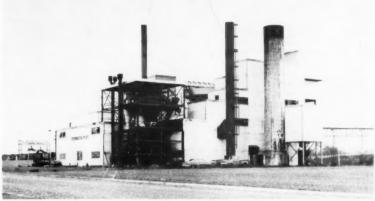
#### Screening

Sizing of coal has always been one of the important phases of coal preparation. There must be accurate sizing on both raw and washed products. The products to be processed must be accurately sized in the plant to give full advantage to the preparation equipment which is to function on any given size or fraction. The ultimate product must be accurately sized to meet the demands of the combustion equipment in which it is to be consumed.

The industry has progressed from the grizzly bars and reciprocating shaker screens of a few years ago to vibrating mechanisms and screens of today which are marvels of precision engineering and manufacture. This is not to infer that grizzly bars and shaker screens are outmoded as there are many good applications for these units in modern coal preparation. Vibrating screens of today will handle raw coal up to an almost unlimited size. Other vibrators will size and dewater down to the very fine sizes. In years gone by, vibrating screens making a small size separation on raw coal would frequently blind from clays and fine, wet coal. Today, the heated wire decks now provided pretty much take care of this trouble. Admittedly, no broad statements can be made and proved. A preparation plant is a tailor made factory tailored or designed to handle a specific type coal in a manner to suit customer requirements.

#### Crushing

Crushing or breaking of coal is as ever one of the more important phases of coal preparation. The Bradford Breaker seems to be making quite a comeback as we hear of more and more installations. In addition, we have the choice of many fine pieces of crushing equipment today. There seems to be



Another view of the Lynnville Coal Co. preparation plant with the new Dorr-Oliver dryer in the foreground

a crusher for every application. Special mention should be made for a washed coal crusher which has been engineered and developed in Illinois by the T. J. Gundlach Co. of Belleville, Ill. The crusher has been on the market for several years, but has come into rather wide use in the past year. It is a two-stage crusher which will take a feed of 8 in. by 4-in. coal and reduce it to a one-in. size in a single pass with a minimum of fines.

#### **Face Preparation**

Highly cost conscious utilities with design know-how are building furnaces to handle lower quality coals. Some furnaces are being designed to burn raw coal. On the face of it, it may seem that we are advancing to the rear in so far as quality control of the product is concerned. Actually, it is conservation of a natural resource and the elimination of preparation plant headaches to side-step the slurry issue with its attendant problems. The

unfortunate fact is that all coal cannot be marketed in the raw state. If a raw coal is to be utilized, it is imperative that we exercise the highest possible degree of face preparation.

#### Washing

Heavy Media washing is now an established process with a large volume of coal handled annually as newer and more simplified versions are being introduced and built. Jigs are continuing their fine work in coal preparation and are even spilling over into the grain industry as separators. The latest adaptation for jigs seems to be the feldspar jig for the cleaning of fine coal. European exponents of feldspar jigging have been praising the process for years. The wet concentrator tables continue to do an outstanding job on the cleaning of fine coal.

#### Centrifuges

Centrifuges continue to improve and to do an ever better job on the fractions of coal on which they work. Centrifuges perform a very vital service in upgrading fuel value in a portion of a product which in times past has been unsalable and therefore a waste. Cyclone thickners have been utilized to great advantage in many preparation plants.

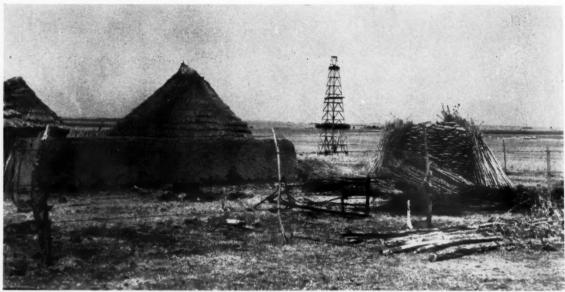
#### **Fine Coal Heat Drying**

A new approach to the thermal drying of fine coal has been brought to a successful conclusion this year and merits consideration. Dorr-Oliver Inc. of Stamford, Conn., has projected their fluidization technique into the drying of fine coal. Dorr claims that the high drying efficiency inherent in a fluidized bed means instantaneous vaporization of surface moisture. The claims are evidently borne out by the results of a 70-tph unit which has been in operation for seven months at the Lynnville Coal Co. of Lynnville, Ind. The new dryer has much to offer in

(Continued on page 125)



Yankeetown Dock Corp. plant showing twin Bradford Breakers for breaking and scalping all raw coal



South African gold is the objective of this diamond drilling exploration project

## Geology in Mining

Basic Geologic Methods With Trends to Diversification,
Application of Specialized Techniques, and
Continuation of the Uranium Search Characterize
a Year of Commendable Progress by Mining
Geologists

By J. D. FORRESTER

Dean, College of Mines, Univ. of Idaho Director, Idaho Bureau of Mines & Geology

THE writer wishes to acknowledge here, at the outset of this article, the kind assistance given by many individuals in the compilation of much of the information that is presented. Indeed, had it not been for such contributions, the preparation of the paper, as a whole, would not have been possible. This being the case, it goes without undue mention that the writer cannot and does not, claim authorship of many of the statements and philosophies that are propounded. However, it is equally evident that did he not generally concur in and subscribe to the proposals that are made, they would not be offered. There has been a tendency, and perhaps an entirely natural one, for many of the correspondents to speak of the success that seems to attend what the "other fellow" is doing but, at the same time, to minimize somewhat the activities in which they personally are engaged—often with marked success. Therefore, because of such reticence, the generalized comments that are made herein about the work of various organizations have not been obtained in all cases directly from respective company representatives. The descriptive write-ups intentionally have been kept generalized wherever a breach of good faith might otherwise transpire.

Although 1955 has been more or less of a "normal" year and, thus, has not been characterized by extremely outstanding events, three major trends appear to have attended and dominated mining and mining geology enterprises. These salient features are: (1) the pronounced movement by mining and petroleum organizations

toward diversification of operations; (2) the ever-growing expansion and application of geophysical and geochemical techniques, and of similar specialized, allied processes, for the discovery of otherwise hidden mineral bodies; (3) the continued intensification and dispersion of the search for uranium and related fissionable materials. There have been several other important activities, of course, but the above three elements are those which seem to have been most impressive, as judged by the amount of comment and attention that has ensued.



The time-tested exploration drill is getting more help from geophysics and geochemistry

#### Diversification

In view of the widespread acceptance of the conclusions adduced by the President's Materials Policy Commission report (popularly known as the Paley report), together with companion analyses made by many other mineral economists in the United States, it now (1955) is generally conceded that our growing require-ments for mineral commodities will exceed our gross national production. That is, the need in future years for mineral materials will be greater than our present ability to produce, and on such bases, our industrial wants by 1975 for minerals will have doubled for base metals and iron, whereas the demand for some additive or alloy metals may be up as much as 1000 per cent. Because of the common recognition of these factors, it follows logically that those who require metals or minerals to conduct their industrial pursuits have been taking sustained steps during 1955 to insure an adequate supply of raw materials. Thus, in order apparently to achieve better management exploratory and operational controls and, at the same time, to participate efficiently and comprehensively in the tremendous industrial expansion that has been in existence through the past several years, many mineral industry companies have markedly widened their interests dur-ing 1955. There has been a growing tendency for mining corporations to form working agreements with other mining companies for the purpose of jointly developing mineral areas. Also, several mining companies have built subsidiary petroleum units and some petroleum and chemical organizations have undertaken to establish mining divisions. In fact, a few mineral producers or fabricators have gone so far as to form special operational units. It is believed that these tendencies toward diversification of interests and activities are the natural consequences of the ultimate shaping of the Industrial Era. By the same process of "coming of age," the individual geologist's enterprise, as he has participated during 1955 in mineral industry events, has been characterized by the increasing need of being able to use more and more complex tools and to envision the broader scope of mineral occurrences. As one colleague has written, "With this accelerating rate of expansion in the mining geologist's field, the pressure will be on him more and more to specialize and I think this is inevitable, as he can't know everything and yet he must make a living at something. Nevertheless, the mining geologist must keep abreast of new developments as well as he can." Many new mineral substances as well as the old are going into broadened and better industrial uses and, also, the extraction of new compounds often is similarly complex. This frequently imposes an added burden on the exploration and development geologist because, among other attributes, now he must have, at least, a modicum of knowledge about mineral markets, market trends, prices and government policies.

With regard to this growing need for expansion and the resultant adaptation of new prospecting tools and techniques there appears to be a concern among some men, who have the balance of experience of many years, that the appreciation of the need of careful attention to geologic detail is being often subdued by what



From 1929 to 1932, and again from 1935 to 1939, JAMES D. FORRESTER was employed in the geological department as geologist and field engineer by The Anaconda Co. In 1939 he was appointed professor and head of geology. School of Mines, University of Idaho and served in this capacity until 1944 when he was appointed professor and chairman of Mining Engineering at the Missouri School of Mines and Metallurgy. Since 1954 he has been dean of the College of Mines, University of Idaho, and director of the State Bureau of Mines and Geology. Dr. Forrester is the author of over 30 published articles and texts on geology and mining and has served as consultant for numerous mining enterprises in the West and Midwest.

is sometimes considered as the more romantic and spectacular methods of geophysics and geochemistry. eral men have written words of caution and of concern that realization not be lost of the importance of such basic professional fundamentals. example, one geologist has written "As far as geological tools and techniques are concerned, I think that geophysics is becoming more and more important, but beyond that, plain detailed geologic mapping is still the most important means of finding ore and maintaining ore reserves." Another man has said, "The old and well-tried methods of careful geologic mapping, coupled with adequate petrographic and mineralogic investigations should be strongly stressed. . These basic techniques have found many orebodies in the past and they will continue to do so in the future." Many of us are prone, it would seem, to accent the spectacular and, in so doing, contribute to some injustice, unintentional as it may be, to the "bread and butter" type of work that goes on day after day, consistently paying-off in success. The benefits to be derived by careful, thorough mining geology applied to producing properties long have been known and they have continued during 1955.

#### **Apply Fundamentals**

Progressive organizations have not lost sight of these factors and, indeed, the studied attention to detail, which is the very original foundation upon which mining geology rests, is gaining ever-increasing application. There are several examples of how such efforts have been applied to operational problems during 1955. J. K. Gustafson has cited the institution of pit mapping by the Iron Ore Company of Canada to help control grade in the iron ore pits in Labrador-Quebec. He writes, "We have there very complicated geologic structures and some problem of grade control with respect to Bessemer and manganiferous grades which pit mapping is helping to alleviate. The geologists have discovered that different types of iron are characteristic of different stratigraphic horizons within the Sokoman iron formation and consequently that mapping of ore types assists in working out the geologic structure." C. P. Pollock of the American Smelting and Refining Company says, "In our work with porphyry copper deposits we are commencing to map structural geology as an aid in mill feed control. We have remapped some porphyry copper outcrops in order to show detailed structural features in conjunction with rock types, mineralization and alteration patterns. We do this type of mapping in connection with stripping operations also throughout the period of ore extrac-We are confident the effort is justified by the additional control this will provide in the elimination of waste material especially in the transition zone going from caprock to ore."

Geologists and officials of St. Joseph Lead Company recently have recognized the importance of primitive algal reef structures and the localization of mineralization in the Bonne Terre formation at properties in Missouri. These structures, which for some years were thought to be alteration phenomena now have been determined to be definite reef structures and, by detailed mapping, it has been found that they have served to localize lead mineralization to such an extent that they appear to be the definite structural control of substantial orebodies. The reef structures are particularly well-developed in the new Indian Creek mine, and it was there that they were first recognized, as such. According to John S. Brown of the St. Joe Lead Company, "They continue to find the detailed study of sedimentary rocks a fascinating business which pays dividends in correlating minor and subtle depositional features on structures with ore receptables."

Another example of the use during 1955 of detailed geology in unravelling the mode of occurrence of an ore deposit has been called to the writer's attention by Arthur Montgomery, owner of the Harding Mine, which is in a beryl deposit associated with a pegmatite body in Taos County, N. M. The beryl-rich zone has been structurally controlled in a broad way by regional deformation and, in a more specific fashion, by the particular shapes and attitudes of the individual rolls in the top of the pegmatite. A knowledge of such structural control helps to make it possible for a crew of four miners to develop and to produce more than 100 tons of beryl a year. Joseph P. Lyden has pointed out that the Tri-State district of Missouri. Kansas and Oklahoma still can be cited as a prime example of the use of good geological deduction based on the knowledge of the geology gained by careful attention to the mapping and interpretation of structural and mineralogical relationships. He writes, "Longhole drilling during 1954 and 1955 has been an important development for prospecting for new ore-bodies in the Eagle-Picher Company's mines and it will prolong the life of the Picher, Okla., field. Longhole drilling has replaced churn-drilling for prospecting within 100 ft of the underground mine workings: it is more economical and can be used to advantage where buildings, ponds, etc., have heretofore interferred with the placing of churn drill holes. The detailed knowledge of the geologic mode of occurrence of the ore deposits as gained by long experience and sound reasoning together with the adaptation of the more flexible method of longhole drilling has made it possible to locate and to develop economically several small orebodies. In many cases, the mineralization in one bed has a vertical structure relationship to that in the beds above and/or below, and long drill holes are spotted to prospect those beds in the most favorable part of the structure which is determined by carefully mapping the geology in the underground work-This brief mention of the use of drilling techniques during 1955 cannot be made without citing the invention and development of one of the most noteworthy advances in drilling practice to transpire since the advent of diamond drilling itself. It has been long recognized that one of the most costly features attending diamond drilling has been the tedious requirement of rod-handling when a core is to be recovered from the barrel. This pronounced disadvantage now has been greatly reduced by the perfection of the Wire-Line Core Barrel by the E. J. Longyear Company. This device, in essence, permits the securing of diamond drill core during a given drilling venture without much of the tedious rod-pulling requirement of the old method. According to R. D. Lynn, The Anaconda Company, in its geological exploration program for uranium in the Grants-Laguna district, "is using diamond core drills equipped with wire line core recovery equipment which cuts a BX size core. Prior to the installation of the wire line equipment, NX size core normally was recovered. Wire line has replaced the standard NX equipment because it has been found to be superior in many respects. Drilling costs per foot have been reduced substantially by wire line as a result of a 50 percent increase in feet drilled per machine per shift. Also, core recovery has improved nearly 10 percent and better samples and a more complete geological record consequently have been made possible."

There are other illustrations that

has proposed that to best apply geo-chemistry in exploration, "We need cases where the ore deposit itself is known and where the object of the study is not to try to find an unknown deposit without 'controls' that tell us whether the approach corresponds with the known facts but rather cases where a known deposit is tested to see whether it gives the kinds of results that we believe should be expected." He mentions that several of such case studies have been made recently, with excellent potential results and, further, John S. Brown has said, "Valuable principles are on the way to development, mainly by the geochemists and, for the long pull, the accumulation of this type of information (geophysics and geochemistry) will be of definite value in Mining Geology."

#### **Comprehensive Approach**

It has become ever-more apparent during 1955 that the pursuit of successful, efficient mining geology en-



What unknown mineral wealth may exist in these rocks?

could be listed about the use of geologic principles in working out the complexities of both metallic and industrial mineral deposits. Many of such articles have been published during 1955 in various scientific and technical journals and, also, the several state and federal agencies, as the U.S. Geological Survey and the Federal Bureau of Mines, have made numerous contributions. R. B. Mulchay has suggested that the "adequate use of newer methods of geophysics and geochemistry must be based on detailed geologic knowledge gained from careful field examinations. Without such detailed knowledge, the best additional geologic tools cannot be successfully applied to specific problems." Somewhat in this same vein, C. H. Behre

tails the adoption of a well-rounded, comprehensive line-of-approach. G. Donald Emigh has comprehensively defined Mining Geology as "any activity involving the study of geology in connection with a mining operation" and he suggests further that, "Mining Geology in the sense I have used it above . . . applies to reconnaissance, exploratory prospecting, actual prospecting of a property, development of a property, and the mining of a property. In all of these functions, the mining geologist has to in some way get as many facts as he can and then interpret them." Thus, all elements of mining geology as an engineering science must be involved if a proper methodology is followed. Just as there is no substitute for detailed

mapping and study so too there is no alternative to the proper employment of all exploratory tools and techniques. As D. M. Davidson has written, "The day of scientific, long-range prospecting for concealed orebodies has arrived as a rightful partner to detailed mapping-it is here to stay, in this country especially. One by one the larger mining companies are falling in line by employing the specialized scientific techniques. . . . They have become mindful of the fact that in order to keep their mineral inventories up to the proper level, more ore must be found by exploratory means because it is no longer possible to buy potentially valuable mines. There are too few to go around and they are not for sale."

The confirming of the existence of major lead-zinc orebodies in the Bathurst district and the Newcastle district of New Brunswick, probably are the outstanding discoveries of base metal deposits to be credited to 1955, at least in the Northern Hemisphere. These ore masses, which have become defined as the result of extensive geophysical and geochemical exploration coupled with careful geological deduction, carried on generally since 1952, occur in tightly folded Paleozoic rocks. They are governed in their location by a structural dome or anticline, the recognition of which has been helpful in the emplacement of drilling and other development work. Two main deposits are known in the Bathurst district, each being over 22,000,000 tons. They were under the direction of the Brunswick Mining and Smelting Company but are now reported to be controlled by the St. Joseph Lead Company. Three orebodies each said to be over 2000 ft long, have been discovered in the Newcastle area, largely through the interest of the American Metals Company.

#### Foreign Explorations

Just as the great lead and zinc discoveries in New Brunswick have been particularly noteworthy in the North American continent, the development of major copper bodies in South America is also of especial interest. "In Peru, a decision was reached to go ahead with development plans at the Toguepala-Quellaveco-Cuajones properties through an operating combine of A. S. & R. Co., Cerro de Pasco Corporation, Phelps Dodge Corpora-tion and Newmont Mining Corporation. In Chile, The Anaconda Company has announced the discovery of a major ore deposit at Indio Muerto, located about 15 miles airline north of Potrerillos. Both of these copper developments are the direct result of geological work done during the course of formal exploration programs. Near Santiago, The Anaconda Company will equip the old Africana vein mine for production."

The American Smelting and Refin-

ing Company is reported to have outlined an important copper deposit at Concepcion del Oro, Zacatecas, Mexico, and in western Sonora, Phelps Dodge Corporation through its subsidiary, the Moctezuma Copper Company, is said to be drilling a copper prospect northeast of Puerto Libertad. Also, there is some exploration activity in the Nacozari district of Mexico. Mexico, geology has continued to be used by mining companies and government agencies to aid in the extraction of ore in known mining districts. On the whole, however, the unhealthy economic climate generally imposed by adverse tax burdens and the controlled status of uranium as a mineral entirely within a national reserve classification, have been continuing deterrents to widespread mineral developments in Mexico.

In contrast, it would seem to the limitations in effect in Mexico, the opportunities for mining land development have been excellent in Canada in 1955. According to Charles H. Mitchell, editor of the Western Miner and Oil Review, one of the reasons Canada has experienced such an ad-



There are new techniques and methods in modern geology, but no substitute for painstaking study and detailed analysis

vance is because "the Canadian governments, both federal and provincial, have shown more than ordinary wisdom in their mineral policies, by providing almost every conceivable form of assistance and encouragement to those endeavoring to find, develop, mine, beneficiate and market mineral resources. Canada has created a climate attractive to the investment of venture capital—a climate that holds out the promise of a reasonable reward for the daring, the venturous and the determined."

Among other activities, the A S & R recently has undertaken exploration and development of the Bethlehem porphyry copper prospect near Ashcroft, B. C. The decision to embark on this program was based largely on geological mapping of scattered small

outcrops interspersed with large areas covered by glacial debris. Geologists have been able to differentiate the complex of plutonic rocks and also map zones of alteration and brecciation.

#### Geophysics and Geochemistry

In the United States, in common with the developments that have ensued elsewhere, the application of geophysical and geochemical methods of exploration has been intensified during the past year. For example, the discovery and subsequent development near Tucson, Ariz., of the Pima Mining Company orebody under 200 ft of valley fill has served as a spur to much more intensive exploration in Arizona and elsewhere in the Southwest. Also, similar geophysical-geochemical prospecting has been done by the American Smelting and Refining Company south and east of Bingham Canyon, Utah, and at Yerrington, Nev., The Anaconda Comhas done extensive geophysical work around the periphery of its new pit. The Bear Creek Mining Company (Kennecott), among other activities has done extensive exploratory testing in the Glacier Peak region of Washington. This work is especially noteworthy as it has been a completely integrated operation enlisting the use of helicopters and other modern devices. The Rare Metals Corporation (El Paso Natural Gas) during 1955 has been successful in its ventures to re-establish mercury production from the New Almaden deposits near Weiser, Idaho. This operation is a splendid example of the success that often attends thorough, well-applied mining geology and related engineering prac-

Exploration for zinc, which has been productive of excellent results, has been carried on in the southeastern states in a most scientific manner by teams of geologists, geophysicists and geochemists. The same sort of searches also have gone ahead in northern New York, and elsewhere. In fact, several of the larger mining companies now employ scores of geologists and geophysicists, all of whom are engaged in long-range prospecting. This type of work often involves searching for buried deposits which procedures generally entail the expenditures of much time and money.

#### Uranium

As a natural consequence of the more mature and rational approach that has superseded the earlier stampede-like search for fissionable materials of the earth's crust, and in particular since the Geneva Conference, there has been a general change in the over-all picture with regard to the exploration and exploitation of uranium deposits. The original "mad rush" and series of promotional enter-

prises that heretofore have attended so commonly the search for uranium deposits now has been replaced by a more sensible and moderate pace wherein the consolidation of properties is being managed by people of substance, who intend to make a real mining industry out of uranium, as an economic commodity. Although the promotional nature of many recent and earlier uranium operations is not within itself necessarily a damning characteristic it has tended somewhat. to enlist the so-called consulting services of a few who are willing to become involved in professional practices of "border-line" nature. During 1955, one well-known consulting geologist has had the forthright moral courage to publicly speak out against such shady practices and thus, by his fortunate but nonetheless generally uncommon and unique process, he has pointed with scorn at the work being done by a few former Government employes and some other individuals.

This "coming of age" of the uranium industry from the standpoints both of sound management procedures and of good exploration practices will be valuable to the mineral industry, as a whole, in this country and particularly to the Atomic Energy Commission. It appears to be a safe conclusion that the United States now is fully protected with regard to raw materials supply from a weapons standpoint and, further, domestic deposits will be able to support the industrial needs that will exist in the foreseeable future. There is, of course, much speculation with regard to the renewal price of North American uranium after 1962 but, inasmuch as South African prices are guaranteed until 1965, it appears likely that the price in this country will be guaranteed at least until the latter date, although possibly on a somewhat different basis.

Important uranium discoveries have been made in the Algoma district and other areas of Ontario and, in British Columbia, the Rexspar Uranium and Metals Co., Ltd., has developed a producing uranium property. According to D. M. Davidson, "Most experienced geologists and engineers now know a great deal more about how to appraise the results of the various means for making radiation surveys from the air, on the surface and in drill holes. As a result of this, exploration has been carried out with tremendous success, probably the best example being the Blind River deposits in Ontario. The significance of this development is both far-reaching and lasting. This is due to the fact that while the radiation surveys were promising, the shallow trenching was most discouraging, which ultimately led to the surmise that these deposits had been leached near the surface. This was subsequently proved to be correct by drilling which resulted in the unearthing of what will probably prove to be the largest uranium reserves in the world. Other prospectors being aware of the fact that leaching occurs in uraninite deposits will now have more courage to probe deeper under outcrops which show radiation, but which yield low chemical assays. There are deposits both on the plateau and in the Piedmont region along the eastern seaboard which must be appraised in the light of the knowledge adduced from Blind River."

For further details of the uranium occurrences in Ontario, the reader is referred to "Recent Uranium Developments in Ontario" by J. D. Bateman, Econ. Geol. Vol. 50 No. 4 (1955).

'The presence of uranium in the Orange Free State in South Africa will have a significant impact on this country, not only because of the uranium which is committed to the Atomic Energy Commission, but also because there are several large gold mines in this area which are only really profitable because of the uranium content. However, in the process of min-

deposit in the United States, namely, the Jackpile mine not far from Grants, This deposit now is being stripped for open cut mining. Its discovery and development constitute one of the most efficient scientific exploration campaigns carried out in this country by one of our larger companies. After its original discovery by means of radiation tests. the property was drilled on 25-ft centers, the corner holes being drilled by means of rock bits, using air as a lubricant and the cuttings being collected in bags for analysis. Many of the holes were probed as well, and in the middle of each square a core drill hole was put down in order to obtain core for chemical analysis to check the analysis of the cuttings from the other holes. The whole enterprise represents the highest type of efficiency and it illustrates the capabilities of modern prospecting and development practices.

One leading mining official has estimated that something like two-thirds



The geologists' conclusions depend upon a great deal of work in the lab

ing uranium, gold will also be produced in large quantities. This gold, like the uranium, will ultimately reach the United States. The South African uranium ores probably rank within the first four districts in the free world with regard to the quantity, quality and the reserves. Shinkolobe is the only known uranium producer in the Belgian Congo. Extensive search is under way for further deposits, and if one is imbued with the idea of proximity of great ore deposits, then the possibilities are hopeful that more uranium will be found in this part of Central Africa. The methods which are or will be used for prospecting will be of the most modern type including air-borne and surface radiation surveys, coupled with geophysical and geochemical surveys."

In the Colorado Plateau area, The Anaconda Company by means of radiation surveys has developed what is probably the biggest single uranium of the geological effort expended this year (1955) has been in connection with the search for uranium deposits and Thomas B. Nolan has written that, "Although we have read a lot about the successes of the prospector in the search for uranium, I have a strong suspicion that more ore bodies have been found by geologists specifically employed to find them during this uranium hunt than ever before. We were fortunate that when it became necessary to find an adequate raw material supply of fissionable material, there were so many economic geologists available to participate in the search." There can be no doubt but that the year 1955 saw the skilled and competent mining geologists progressing a long way in unravelling the structures and uranium occurrences throughout the mineral producing world, as a whole.

(Continued on page 112)



Titanium sheets, 3 ft by 8 ft by 0.025 in. made on a continuous sheet mill, at final inspection

### **Titanium**

Mill Products Output Increased Over 50 Percent Since 1954 and Greater Proportionate Increase Is Predicted for This Year

By C. I. BRADFORD

President Rem-Cru Titanium, Inc.

PRODUCTION orders for military aircraft placed by the Air Force in the fourth quarter of 1955 already have assured a major expansion of the use of titanium mill products in the year 1956. It will be of considerable interest, then, to look at the titanium industry from the point of view of how this greatly increased demand will be met.

#### **Abundant Ore Supplies**

First, one of the most encouraging factors for the long range development of titanium as a tonnage metal industry is the abundance of the ore. Titanium is not only one of the most plentiful metals in the earth's crust, but there are ample workable deposits in both the United States and other parts of the world. In addition to large amounts of domestic ores, plentiful deposits of ilmenite in both Canada and Mexico are awaiting development.

Titanium sponge manufacture has

been greatly expanded with the help of Government contracts for new plants. Sponge production has been running well ahead of the demand for mill products during 1954 and 1955. In addition to the greatly enlarged sponge production facilities, a large tonnage of sponge has been delivered to the Government stockpile.

In 1954, virtually all of the world's production of titanium sponge was made by E. I. du Pont de Nemours & Co., Inc. and Titanium Metals Corporation of America. During 1955, titanium sponge was sold to the manufacturers of mill products by DuPont and by Union Carbide and Carbon with significant quantities being imported from Japan. Deliveries to the Government stockpile were made by DuPont, Titanium Metals (who also supplied sponge for their own mill products manfacture), Dow Chemical Co. and Cramet, a subsidiary of the Crane Co.

The great majority of this sponge was produced by the magnesium re-



C. I. BRADFORD has been associated with the relatively new titanium industry since 1947 when Remington Arms Co., Inc., began investigating the alloying and fabricating of titanium. At that time he was placed in charge of pilot production, sales and general development. With the formation in 1950 of the new company. Rem-Cru Titanium, Inc., jointly owned by Remington Arms Co., Inc. and the Crucible Steel Co. of America. Mr. Bradford was appointed director of operations. During the last five years, when Rem-Cru's production has expanded from a laboratory-pilot plant scale to a tonnage business, he has been in charge of all phases of the company's operations. In 1954 he was appointed president and general manager of the company.

duction of titanium tetrochloride under vacuum, which is based on the process originated by Wilhelm Kroll. Union Carbide and Carbon is reported to be using sodium reduction of the chloride.

No production deliveries of the much discussed electrolytic processes have



Titanium components of calcium hypochlorite crusher for Pennsylvania Sait Manufacturing Co.

been made as yet. Horizons Inc. reportedly is now producing pilot quantities by an electrolytic process under a U. S. Government Research and Development contract. Shawinigan Power and Light Co. in Quebec, Canada, is also said to be in pilot production with a process based on fused salt electrolysis.

#### **Mill Product Manufacturing**

Four major American producers are manufacturing titanium in the form of mill products. These are Remcru Titanium, Inc., jointly owned by Remington Arms Co., Inc. and the Crucible Steel Co. of America; Titanium Corp. of America; Mallory-Sharon Titanium Corp. and Republic Steel Corp. While the producers of sponge have received Government contracts, the producers of mill products have received no direct Government aid except in the form of research and development contracts.

From 1948, when the first experimental quantities of ductile titanium were produced, until 1953, there was a rapid expansion of titanium mill products to slightly over 1100 tons in 1953. During 1954, there was only a small increase, to about 1200 tons.

In retrospect, the major reasons for the lack of expansion in 1954, the progress in 1955 and the outlook for 1956 appear to be as follows:

(1) Questions and uncertainties regarding quality have existed. During 1954 and 1955, important quality improvements were made by the producers with respect to uniformity of the product, control of hydrogen, sheet flatness and providing more rigid standards for mechanical properties. In 1956, we anticipate these quality improvements will continue

(2) Delays, unrelated to titanium, in airframe and engine production programs have existed but now appear to be resolved.

(3) There was a natural reluctance of the aircraft companies to design titanium into production applications while there remained a doubt that there would be enough titanium available to meet their requirements. When this obstacle was effectively removed by the expansion of sponge capacity, the demand for titanium mill products resumed its expansion. Final industry



Titanium engine shroud for the Convair F-102 Supersonic Interceptor

figures for 1955 are expected to show an expansion from about 1200 tons of mill products delivered in 1954, to between 1800 and 2000 tons in 1955. An expansion of at least comparable proportions is forecast for 1956.

#### Non-Defense Uses

During 1955, encouraging pilot plant applications in the chemical process, pulp and paper, electronics and other industrial fields have greatly increased our confidence of early widespread non-defense use of titanium and a healthy distribution between civilian and military use for the future of the industry. These industrial consumers are protected by the Department of Commerce order M-80 which allows the producer of mill products to channel up to 10 percent of his output to such non-defense applications.

Over half of the titanium used by the aircraft industry is in the form of alloyed titanium. The metal has been combined with from one to eight percent of manganese, aluminum, tin, iron, chromium and vanadium—alone or in various combinations. However, aircraft designers are looking for new alloys which will give even better strength and formability than provided by the grades now in production. Several of these which are now in the laboratory stage are quite encouraging, and should be ready for widespread evaluation during 1956.

The year 1956 promises to be one of important advances for the titanium industry; in customer confidence, in increased production and consumption and in important technological advances, particularly alloy development.

#### Open Pit Mining

(Continued from page 77)

#### **Cost Distribution**

Oftentimes a comparison of cost distribution between an individual property and the average of a group of similar operations can be helpful in spotting deficiencies. Many factors, such as geography, production rate, labor shortages, accounting methods, and ore types, have an important influence, but it is still well to know your relative position to others. In reply to the general inquiry sent to companies in all fields of surface mining, 42 operations kindly forwarded

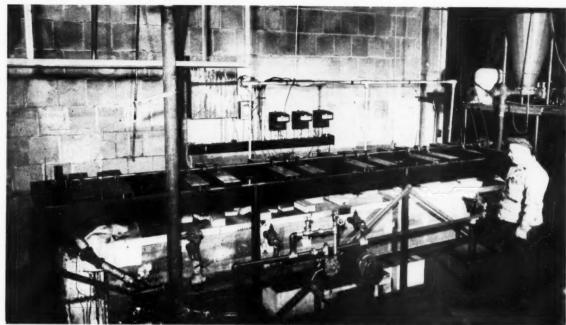
data on their cost distribution. These figures are summarized in Table II.

If your percentage for labor is in the high range, replacement of equipment with more efficient methods or models might be in order. The figures on ratios are also valuable for estimation purposes, since it is simpler to estimate the personnel requirements than the many small items making up material, power and expense charges.

The author wishes to acknowledge, with thanks, the information supplied by the management and operating personnel of many foremost open pit operations, as well as that gleaned from the numerous fine articles published in the technical literature during 1955.

TABLE II—DISTRIBUTION OF OPERATING & MAINTENANCE COSTS AT OPEN PIT OPERATIONS—1955

|            |                   | Rang     | e-Percent                    | Arerage—Percent |                             |  |
|------------|-------------------|----------|------------------------------|-----------------|-----------------------------|--|
| Product    | No. of Operations | Lubor    | Materials Ex-<br>pense Power | Labor           | Material Ex-<br>pense Power |  |
| Cement     | 8                 | 26 to 62 | 74 to 38                     | 45              | 55                          |  |
| Limestone  |                   | 32 to 62 | 68 to 38                     | 51              | 49                          |  |
| Iron Ore   | 4                 | 25 to 57 | 75 to 43                     | 45              | 49<br>55                    |  |
| Copper Ore |                   | 30 to 56 | 70 to 44                     | 46              | 54                          |  |
| Over-all   | 42                |          |                              | 47              | 53                          |  |



Retort for producing low-temperature char at laboratories of the Illinois Geological Survey

### Coal Research

World-Wide Efforts Directed Toward Widening the Fields of Industrial Application

By HARLAN W. NELSON

Chief, Fuels Technology Division Battelle Memorial Institute

THROUGHOUT most of the world in 1955, the availability and utilization of mineral fuels and other sources of energy have demanded the attention of government and industry. Shortages of coal were reported by many countries as rising industrial activities outstripped the fuel supply, and there were expanded efforts to develop and upgrade inferior coal deposits for various industrial applications.

In this country, the cautious optimism expressed by some bituminous coal operators late in 1954 that the low point in production had been passed was borne out in 1955, and production has substantially exceeded that of the preceding year. Increased use by coke-oven plants and electric utilities and increased exports highlighted the expanded demand.

The increasing demand for energy has, in the opinion of many economists and engineers, led the coal industry of this country into the beginning of a period leading to rapid development and expansion. This expansion will result in large part from gradual but substantial increases in demand for coal by electric utilities, steel plants, light-metal producers, and, finally, by demands of the chemical industry and the beginning of synthetic fuel production.

Perhaps in no other period has it been so evident that research on coal technology can and will lead to wider fields of industrial application. If the use of coal is to rise to the heights predicted for the future, its position in the energy-use system must be made more secure and profitable by research to develop better and more economical ways to mine, prepare, and use coal.

#### **Properties and Constitution**

Work on the occurrence, properties, and constitution of coal continued during 1955 in a number of laboratories. Since utilization depends so strongly on knowledge of these physical and chemical factors, such studies



HARLAN W. NELSON has long been associated with research on stokers, coal gastification. combustion phenomena, and utilization studies. For 10 years he was associated with the Department of Fuel Technology, Pennsylvania State University, after which he joined the Battelle Memorial Institute in 1944. He is now a supervisory engineer in fuels and combustion research at Battelle. Dr. Nelson is the author of numerous publications on residential stokers and stoker coals, gasification of solid fuels, pulverized coal, gas burners, and combustion technology.

are an important phase of coal research. The United States Geological Survey continued its work on the assessment of coal reserves, aided by data collected by many of the Geological Survey groups in the coal-producing states.

The Illinois Geological Survey conducted basic geologic studies of detailed stratigraphy and coal resources within the state. Included were studies of geologic factors influencing

the character of mine roofs and fault patterns in mine areas. The United States Bureau of Mines completed additional studies of the known recoverable reserves of coking coals. Coal reserves in Ohio were studied by the Ohio Geological Survey.

Studies at the University of Alabama in cooperation with the State Mine Experiment Station were concerned with the petrographic composition of coals. Petrographic studies were also made on Ohio coals at the laboratories of the Ohio State Geological Survey. The Explorations Office of the Atomic Energy Commission in cooperation with the U.S. Geological Survey continued its studies of uranium-bearing lignites including methods of extraction. The relation between the petrographic composition of coals and their coking properties was the subject for investigations conducted at the Pennsylvania State University.

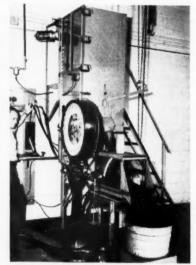
A comprehensive report covering the work of several years on the characteristics of West Virginia coals was issued by the Geological Survey of that state. The report contained data on physical properties, sulfur, and inorganic elements, and is concluded by discussion of the changes in concentrations of the inorganic constituents during utilization. Methods of analyzing and testing coal were the subject of studies at Ohio State University. A report covering the chemical and physical properties of the Ohio No. 9 bed is being prepared. It will include the results of petrographic studies made by the Ohio State Geological Survey.

The Illinois State Geological Survey has made further progress in their studies of the constitution and properties of Illinois coals, including paleobotanical and petrographic investigations, X-ray diffraction studies, and basic work involving differential thermal analysis and comparative oxidation studies of known organic compounds. Over 20 publications covering their work on coal were issued by the Survey during 1955. Pennsylvania State University is continuing research on the constitution of coal, and has initiated projects involving the structure of anthracite and activation phenomena, and the effect of exposure of bituminous coal to different organic compounds in relation to its subsequent coking behavior.

A technical committee on solid mineral fuels formed by the International Organization for Standardization is attempting to formulate standard methods for evaluating coals entering international trade. Because of the rising export trade, American industry is interested in this work, and representatives of the American Society for Testing Materials and the American Standards Association have attended meetings of the Committee in Europe, including one held in Sweden, June 6-10, 1955. Methods for

proximate and ultimate analysis, sulfur, calorific value, caking and coking properties, and ash-f.sion properties are under consideration, and considerable progress is being made. Of special interest is the work on formulation of a system for classification of coals by rank, including the standard ranking of caking and coking properties. Representatives of the U. S. Bureau of Mines and the Illinois Geological Survey have played prominent parts in the work of the Committee.

To augment its services to the coal industry, Bituminous Coal Research, Inc., has recently established in Pittsburgh a laboratory for bench-scale chemical and process studies on coal. This facility will supplement the work of the Columbus laboratory where development of equipment and methods for the utilization of coal is emphasized.



Equipment for studying flow of aerated coal at the Columbus laboratory of BCR

#### Mining and Preparation

Because of the obvious relationship to the price and competitive position of coal, work in this category is being conducted intensively by coal producers, government agencies, and the manufacturers of mining and preparation equipment. For much of this work, the development laboratory is the working mine or preparation plant, where the equipment manufacturer and the producer cooperate in proving new and improved equipment and systems designed to produce coal in the most efficient and least expensive manner. Much of the work reported in this review last year was continued during 1955 by the U. S. Bureau of Mines, Geological Surveys, universities and equipment manufac-

A new Division of Anthracite was established within the U.S. Bureau of Mines, the purpose of which will be

to supervise the Government's part in the multi-million-dollar cooperative state and federal mine-drainage project in the anthracite district of Pennsylvania, and to engage in an enlarged program of research on anthracite. Headquarters for the Division will be in Schuylkill Haven, Pa. The new program will result in expanded research on new and improved mining methods and equipment, and the development of uses for anthracite in the industrial market.

The program of the Mining Development Committee of Bituminous Coal Research, Inc., is being continued, with emphasis placed on investigations of face-transportation systems and roof support for continuous machine mining. The continuous miner developed under this program has reached the commercialization stage, and production models designed and built by the Cleveland Rock Drill Plant of Westinghouse Air Brake Co. are being tested in producing mines. When all tests and production requirements have been met, the miner will be ready for marketing. Based on earlier studies of main-line transportation in coal mines, the Committee has established a cooperative agreement with an equipment manufacturer for economic and pilot-scale studies of the system. If results are favorable, the study will be extended to full-scale surface operation. The conveying system is intended for use in both surface and underground operations.

Development of an ammonium nitrate based explosive was announced by Maumee Collieries Co. The explosive is relatively inexpensive, convenient to handle, and is particularly adapted for stripping operations. Studies of drilling and blasting were made at the Missouri School of Mines.

Research conducted over a period of years by the Pittsburgh Consolidation Coal Co. on the hydraulic transportation of coal by pipeline reached the stage of industrial application. Construction was started on a 110-mile line from Georgetown, Ohio, to the site of an electrical utility plant in Cleveland. Over a million tons a year of fine-sized coal will be sent through the system. The U. S. Bureau of Mines is also conducting studies of the feasibility of transporting low-grade coals by pipeline to industrial areas.

Preparation studies were continued at the U. S. Bureau of Mines, and several more reports on the preparation characteristics of coals from various regions were published. Studies of washability characteristics and preparation methods were also carried on by Pennsylvania State University, Ohio State University, University of Washington, West Virginia University, and by a number of steel companies.

Studies are under way at the labora-

tory of Bituminous Coal Research, Inc., to determine the effectiveness of wetting agents in the dewatering of coal after washing. This laboratory is also investigating the flow characteristics of aerated coal for application in the transport of coal from a bunker to the point of use. Relatively coarse coal with top sizes up to % in are being used in this study.

#### Combustion

Pennsylvania State University continued its studies of industrial underfeed stokers. Some test work involving a residential stoker-furnace unit was carried on by Bituminous Coal Research to determine the operating characteristics of the unit with a range of bituminous coals, and tests of stoker controls were conducted. The automatic Downflow residential stokerboiler developed by BCR several years ago, was further developed for use with Nova Scotia coals by the Dominion Coal Co., Ltd., of Halifax, Nova Scotia, and the unit is now being marketed and sold commercially in that area. The program of the Illinois Geological Survey included combustion tests relating to the performance characteristics of residential stoker coals.

The program of Bituminous Coal Research for the past two years has emphasized work on the development of a coal-fired automatic steam generator in the size range of 1500 to 20,000 lb of steam per hour. Work on the first unit, consisting of a Kewanee fire-box boiler and an American Engineering Co. Vibra-Grate stoker, was continued, using a control system designed by BCR. Additional work is planned, using a combination of a Riley oscillating-grate stoker and a

water-tube boiler to be built by International Boiler Works Co. Tests are also in progress on the adaptation of the Fire-Jet anthracite burner for use with caking bituminous coals. These projects represent an effort by the industry to provide an automatic coalfired package unit within the limits of initial costs of competitive fuel equipment.

Babcock & Wilcox Co. and Combustion Engineering, Inc., have been engaged in development of boiler systems to be operated above the critical pressure. Work was also continued on development of the cyclone furnace, on corrosion and deposits on boiler surfaces, on the study of coal-ash slags, and on the firing of low-grade coals. An ash-sintering test was developed by Babcock & Wilcox for use in determining the tendency of coal ash to form hard, bonded deposits on boiler surfaces. Research involving coal combustion was also carried on by a number of other equipment manufacturers and by electric utilities.

The Annual Gordon Research Conference on Coal was held the week of June 20 at New Hampton, N. H. This conference, sponsored by the American Association for the Advancement of Science, is devoted largely to the fundamental aspects of coal technology, and its unrecorded sessions lead to free discussion and exchange of information among those present. Half of the program this year was devoted to research reports covering the fundamentals of combustion processes, and problems in combustion technol-The remainder of the session included discussion of the kinetics and mechanism of the gasification of solid fuels, the production of high-Btu gas from coal, hydrogenation of coal in a fluidized system, and methanization reactions by catalytic methods.

Several coal-industry organizations have been working on the design of coal-fired steam plants, the selection and integration of combustion equipment, and improved methods of coal and ash handling. The engineering department of the National Coal Association completed a study of the solid fuel requirements of all stations of the Department of the Navy which use coal. The report listed recommendations for storing and handling coal at each station, and for the purchase of coal by size and analysis.

#### Gasification

With the acceptance by industry of the atmospheric-pressure gasification process developed at the Morgantown Laboratories of the Bureau of Mines, work on this process was discontinued. Work is now being concentrated on efforts to develop a practical system for gasifying coal under pressure. Studies are in progress on a pulverized-coal gasified operating at pressures up to 20 atmospheres. The gasifier employs a down-shot burner with the gas offtake at the bottom. Studies of the effect of heat losses in pressure gasification have been made.

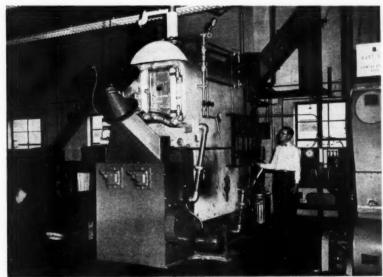
Data from previous runs in the atmospheric-pressure gasifier involving comparative tests of subbituminous, bituminous, and anthracite have been analyzed and evaluated in terms of the percentage of carbon gasified at given oxygen/steam ratios.

Other research studies in progress are concerned with the removal of dust from gases, and the removal of carbon dioxide and hydrogen sulfide from synthesis of gas in an agitator absorber system. Work is also in progress on methods of feeding coal into a pressurized reactor. Methods under investigation include star-type feeders and a slurry injection system.

An improved catalytic process for the conversion of synthesis gas to methane was announced by the U. S. Bureau of Mines Laboratory at Morgantown. The development is of interest in connection with the manufacture of high-Btu pipeline gas.

Another step in the commercialization of coal gasification was taken the past summer when the Olin Mathieson Chemical Corp. announced plans to install an experimental synthesis-gas unit at its plant in Morgantown, W. Va. If operation of the plant is successful, it is planned to convert the entire plant to production of synthesis gas by direct gasification of coal instead of coke.

Additional reports have been issued by the Institute of Gas Technology concerning the production of high-Btu gas by the pressure gasification of pulverized coal in a slagging reactor. The purified synthesis gas is converted into methane in a catalytic



Pilot model of an automatic steam generator undergoing performance tests at laboratory of BCR



The new U. S. Bureau of Mines Experiment Station at Morgantown, W. Va., was dedicated during the year

methanization reactor. Developers of the method claim that strip coal in coal-producing areas can be converted to gas by this process, and the gas delivered to the customer's furnace at a lower cost for space heating than by delivery of the raw coal.

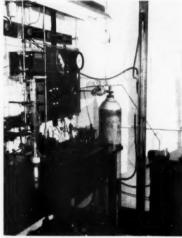
Hydrocarbon Research, Inc., has continued gasification experiments with anthracite and silt with the objective of using these fuels for the production of synthesis gas. Work on gasification and hydrogenation of bituminous coal is continuing in the laboratories of the Koppers Co. Studies of the single-step process for the hydrogenation of coal to produce liquid fuels were made by the Synthetic Fuel Laboratories of the U.S. Bureau of Mines at Bruceton, Pa. Pilotplant tests of this process last year gave nearly complete conversion of the coal substance to heavy oil. However, only small amounts of gasoline and light-weight oils were obtained, and a redesign of the reactor was made. Tests of this process are continuing.

The staff at Bruceton also continued studies of catalysts for the Fischer-Tropsch process of converting synthesis gas into liquid hydrocarbons and other organic compounds, including pretreatment and activation studies of iron and steel materials. Investigation of product separation methods and analytical techniques were also carried on.

Dedication ceremonies were held in the fall of 1955 at the Morgantown Station of the U. S. Bureau of Mines. The Station now houses all activities formerly carried on at various locations in the Morgantown area. Studies in connection with operations in underground gasification were made by the Bureau of Mines in cooperation with the Alabama Power Co., Stanolind, and the Halliburton Oil Well Cementing Co. Tests were made of a hydraulic process for fracturing a bed of coal in preparation for gasification underground.

Considerable interest was aroused in the announcement that the U. S. Bureau of Mines and the Atomic Energy Commission were cooperating in a feasibility study involving the use

of a nuclear reactor to furnish the heat required for gasification of coal with steam. If synthetic gas could be generated in this manner, it is believed that significant savings would result through elimination of the need for oxygen. Although formidable difficulties are forseen in regard to con-



Apparatus used at Pennsylvania State University for determining the macro porosities of coals and carbons

struction materials and operation of a high-temperature (2000-3000° F) reactor of this type, it is understood that more detailed feasibility studies of reactor design are being arranged by the Atomic Energy Commission. Chemical and steel companies are also interested in the development of a reactor of this type, and in the application of nuclear heat to chemical and metallurgical processes.

#### Carbonization

The Koppers Co. continued its research on the carbonizing characteristics of coals, carbonization methods, coal chemicals, and associated subjects. Reports of work covering aromatic chemicals from coal carbonization, the production and use of iron coke, and materials handling in coke-oven plants were given at technical society meetings during 1955.

At the Illinois Geological Survey an intensive program of tests was scheduled using the newly developed pilotscale movable-wall test oven. The work included measurement of expansion pressures, an evaluation of the effects of coal size, and comparative tests of Eastern and Illinois coals. Other projects concerned the physical testing of coke and an analysis of the effects of banded constituents on coking properties based on laboratory-scale tests.

Studies were also conducted on the use of low-temperature char as a substitute for low-volatile coal in the production of metallurgical coke. Char made from Illinois coal was produced in a pilot-scale vibrating retort designed and built in the Survey laboratories on the Storrs principle. Cokes of good quality were produced using char made from Illinois coals. Results of the work were reported recently.

Gulf Research and Development Co. has reported on work involving the solvent extraction of lignite and carbonization of the extracts. Destructive distillation of the extract yielded liquid in amounts equivalent to 52 percent of the dry lignite. An investigation of the effect of coal moisture on carbonization yields was made by the Bethlehem Steel Co. in full-scale tests.

Economic and engineering studies of the recovery of hydrogen from cokeoven gas for chemical processes, long practiced in Europe, have been made by several industrial concerns including the United States Steel Corp., Geneva Division, and the Alabama By-Products Corp., in conjunction with the Hercules Powder Co. As a result of these studies, plants based on the recovery system are being constructed by these organizations for the production of hydrogen to be used for the synthesis of ammonia and associated products.

The research program of the U.S. Bureau of Mines on coal carbonization mentioned in the 1954 review was continued. The work included studies of carbonization characteristics of various coals, the effects of temperature, charge density, and blending on carbonization results, and the correlation of data from carbonizing tests. Work on the Parry process for the lowtemperature carbonization of low-rank coals by a fluidized process was continued, including studies of the resultant tar products. The Bureau's Lignite Research Laboratory in Grand Forks conducted an investigation of the utilization of lignite tars.

The Bureau has also investigated the use of anthracite as a blend ingredient in the production of metalurgical coke. Small tonnages of anthracite have been used for many years in blends for the production of foundry coke. The amount used for carbonization purposes during the past year was increased substantially.

Last year's review mentioned the fluidized-bed lignite carbonizer constructed as a prototype unit at the Rockdale, Texas, plant of the Aluminum Co. of America, following development of the process by the Bureau of Mines. The industrial utilization of the tar produced at this plant is the subject of a large-scale research program at Battelle Memorial Institute under sponsorship of Alcoa and the Texas Power and Light Co., which operates the Rockdale lignite-fired power plant. A preliminary report on this work was given at the fall meeting of the American Chemical Society.

Pittsburgh Consolidation Coal Co. continued an intensive investigation of the low-temperature carbonization of bituminous coal. A large part of this effort was devoted to the study of the composition, fractional separation and recovery, and utilization of the tars produced by this process. As an out-

growth of their research and development work in the field of coal-derived chemicals, including tar acids, Pittsburgh Consolidation has recently announced the acquisition of plant facilities for producing tar acids and associated products. Although initially using products from oil refineries as primary feed materials, the plant will provide a future outlet for materials from low-temperature coal-carbonization plants as such plants materialize, and signals the entry of Pitt Consol into the chemical field.

Work at Montana State College was concerned with the development of a process for the low-temperature carbonization of coal. The investigation was made using an experimental retort system having a capacity of one ton of coal per hour. Plans are being made for the construction of a large-scale pilot plant to develop the process

on a commercial basis.

### Research Abroad

Because of the increasing demand for fuels, many foreign countries have expanded activities in connection with the development of coal-producing areas and the search for improved and more efficient ways to use coal. Significant advances have been made in the development of processes of gasification and carbonization, and commercialization of some has met with considerable success.

#### England

A program of research on coal carbonization and the production of metallurgical coke and smokeless fuel has been carried on in the Stoke Orchard Laboratories of the National Coal Board. A partial list of subjects for investigation includes the plasticity of coal, fissurization of coke, the production of highly reactive coke by pretreatment of coals, the thermal decomposition of coals, and the production of coke by a combination of processes involving low-temperature fluidized carbonization and briquetting, and a finishing thermal treatment employing sand as a heat carrier.

Research is being continued by the National Coal Board at their Isleworth establishment on improved mining machines, hauling methods, and preparation practices. The Board conducted full-scale experiments in Scotland on the transmission of coal vertically by hydraulic means from the bottom of a mine shaft to the surface. This work was based on earlier pilot-scale tests of vertical hydraulic transmission by the N.C.B. and the French Laboratoire Dauphinois d'Hydraulic. In operation, coal sized to pass a three-in. screen is injected into the hydraulic main. Upon reaching the surface section, the coal is discharged onto a dewatering conveyor, and the water is pumped to a settling tank. An extension of the hydraulic work is planned for the transport of coal from the working districts to the shaft bottom.

The Boiler Availability Committee, composed of representatives of the Central Electricity Authority, the Water Tube Boilermakers, the Fuel Research Station, and the British Coal Utilization Research Association, continued their work on corrosion and boiler deposits in steam-generating plants. The work under their direction covers laboratory investigations into the influence of fuel characteristics, combustion conditions and surface catalysis, as well as pilot-scale work and full-scale field trials. cause of the trend toward higher steam temperatures, and the use of coals higher in sulfur and chlorine content, the work of the committee is becoming increasingly important.

A large program of work is being carried on by the British Coal Utilization Research Association. This includes studies of the constitution and properties of coal by solvent extraction, X-ray diffraction, infrared and chromatographic methods, and chemical treatment. Commercial uses have been found for some of the extracted products. Studies were also made of the fluorination of coal which resulted in the production of liquids and solids having properties of sufficient interest to justify further study.

Work was continued on stoker-fired boilers, including conditioning of the fuel and the determination of the wetness of steam. Studies were made on the effects of humidifying combustion air in relation to the formation of boiler deposits in pulverized-coal-fired

installations. Work on domestic heating appliances, gas producers, pelleting of coal fines, flame radiation, and combustion problems in general was continued in the BCURA laboratories at Leatherhead.

The Ministry of Fuel and Power is sponsoring investigations leading to the development of a coal-fired gas turbine. Several types of gas turbine and combustion systems are being investigated by industrial concerns under contract with the Ministry. BCURA and the Fuel Research Station are engaged in studies of combustor designs, of dust removal from hot gases, and of turbine blade deposits and corrosion. The complete gasification of coal is being investigated by the Gas Council, and by several other research organizations and industrial laboratories. Some work on underground gasification is being continued by the Ministry of Fuel and Power.

Current projects at the University of Sheffield include studies of heat transfer, the combustion of single particles of coal, the constitution of coal by solvent extraction in which ultrasonics are used to increase the rate of extraction, and chromatographic separation. The froth flotation of coal is being studied at the Department of Mining, University of Birmingham.

#### Netherlands

Most of the research activities on coal in the Netherlands is done at the laboratories of the Dutch State Mines. One division of the Research Laboratory is concerned with all aspects of research on mining methods, mine machinery and equipment, and coal preparation. The other division is responsible for research on the properties and constitution of coal, processing studies, and utilization.

A continuing study of the constitution of coal under the direction of Dr. van Krevelen, Director of the Research Laboratories, has resulted in valuable information and techniques in this area. Fundamental research is in progress on the physical properties of coal, coal plasticity and the kinetics of coal carbonization, mild hydrogenation as a tool in the study of coal structure, differential thermal analysis, and the molecular distillation of coal.

Research is also being conducted in the fields of coal gasification and highpressure chemistry, especially in regard to acetylene.

The Flame Radiation Committee completed plans in 1955 for experimental studies of radiation in pulverized-coal-fired equipment at Ijmuiden.

#### Germany

Research on all phases of coal technology is being actively pursued in Germany at laboratories of universities, various industry organizations, coal producers, and equipment manu-Important research defacturers. velopments in coal gasification have been brought to the stage of successful commercialization. Lurgi pressure gasifiers are being used to produce synthesis gas or fuel gas from coal in Germany, Czechoslovakia, and the Union of South Africa, and other plants are being constructed in Australia and Pakistan. The Koppers-Totzek pulverized-coal gasifier is being used to produce synthesis gas for ammonia production in Finland and France, and another plant is being built in Spain.

Other gasification studies are in progress, most on a pilot scale, at Recklinghansen on the Ruhrgas process for the production of low-Btu heating gas from pulverized coal, at Dr. C. Otto and Company on a crossdraft gasifier for high-ash fuels, at the Union Rheinische Braunkohlen-Kraftstoff A.G. on the Rummel molten-slag process, and at Badische Anilin and Soda Fabrik on the Flesch-Demag twin-generator process.

Research is also being carried on in the fields of coal constitution, mineral matter, combustion and boiler deposits, coal production methods, coalderived organic chemicals, and coal carbonization.

#### France

The 1954 review of coal research listed the principal subjects for research by the Centre d'Etudes et Recherches des Charbonnages de France (CERCHAR), the principal organization for research on coal in France. Much of the work concerned

with mining and preparation of coal, combustion, carbonization, and gasification was continued during 1955.

Although considerable work on coal preparation has been reported in the past, few studies on that subject are now in progress. Emphasis is being placed on the examination and testing of all types of mining equipment, on factors affecting mine safety, and on explosives. Work on silicosis comprises an important phase of studies at CERCHAR.

An experimental plant at Marienau is carrying on extensive pilot-plant studies of coal carbonization, particularly in regard to use of the weakly-caking coals of Lorraine and the Saar. Use of low-temperature char in cokeoven charges has been studied extensively, the most recent efforts being directed toward the development of a fluidized-bed retort for char production. A pilot retort having a capacity of one ton per hour is under test.

Further studies of the mechanism of carbonization are being made, the main objective of which is to find laboratory tests to provide means of assessing the coking properties of coal mixtures. Methods of X-ray examination of coals undergoing carbonization have been developed. Studies of fissurization and the cohesion of coke are being continued.

#### **Other Countries**

Coal research in Canada has proceeded largely as outlined in the 1954 review. A report on development studies of an experimental coal-fired gas turbine was recently given by workers at McGill University. Following a program of tests with Nova

Scotia coals in the Downflow automatic stoker-boiler unit developed some time ago by Bituminous Coal Research, Inc., marketing of the heating unit was begun by the Dominion Coal Co.

Japan now has about 26 laboratories engaged in the study of coal and its utilization: 11 are located at universities, and two are under government management. The most active field is in the fundamental study of the nature of coals, including their coking properties, but the problems of coal cleaning, carbonization, gasification, and analysis are also being studied. Work on the carbonization of coal in the fluidized state and the complete gasification of pulverized coal has been started. The Government has recently formed a committee to investigate coal technologies relating to the conversion of Japanese coals into more useful and high-value products.

The Fuel Research Institute of India is investigating the low-temperature carbonization of Indian coals in a pilot-scale fluidized-bed reactor. Studies of the distillation, separation, and utilization of the tar fraction are being made. Other research in progress is concerned with the chemical and physical properties of coal, and studies of Fischer-Tropsch synthesis reactions and catalysts.

Not much is known concerning the organization of coal research activities in Russia, but the number of articles being published would suggest that considerable effort is being expended in this field. Work being reported covers a wide variety of subjects, including coal constitution, carbonization, gasification, combustion, and production.

#### Geology

(Continued from page 104)

#### Need Qualified Personnel

The quest for industrial minerals goes on apace and the list of nonmetallics which are under active exploration today is astounding. These are not being sought only by so-called mining companies, but chemical manufacturing concerns and those dealing primarily in fertilizers also are extensively involved. Davidson com-ments further that, "the search for minerals is on and it will be a permanent one. Inevitably this will result in an increasing demand for geologists and mining engineers. I have no doubt concerning the ultimate success of finding the needed materials. A matter that deserves utmost concern on all sides is the shortage of scientific and technical personnel. First, we need more good teachers, and to get them we must pay more. It is the duty not only of the colleges, but of industry as well to take note of this vital shortage. In all likelihood we are going to be short of trained, experienced geologists within the next decade. This, too, is a matter of grave concern. It has been wisely suggested, I think, that we provide more scholarships for undergraduates to attract high school students who are interested in earth sciences. Then, too, we are seriously understaffed in our mining organizations by those who have judgment, initiative and vision. One of the gravest matters in this country today is the shortage of young, able executives. Perhaps you are thinking I am getting off the subject. However, I firmly believe that these matters of technical and managerial personnel are very directly related to a healthy mineral industry.

Before closing, the author would be remiss if he did not take this opportunity to remark that the Federal Government still appears to have difficulty in fixing on a satisfactory policy concerning domestic and foreign mineral materials. This situation has had and, until remedied it will continue to have, a deleterious effect on mineral land exploration and mine develop-

ment. In the writer's opinion, the modifications that were accomplished during 1955 in the Federal Mining statutes is another element that will eventually have a pronounced consequence on all phases of mining operations. The Forest Service of the Department of Agriculture already has established field forces to analyze the validity and general character of mining claims within some sections of the Public Domain and other governmental controls are being rapidly imposed.

In the foregoing an attempt has been made to present the more salient characteristics that attended mining geology during 1955. Because of space limitations, the results necessarily must be sketchy and, it is feared, often are markedly incomplete and insufficient. By way of some apology and of explanation it can be said only that specific data frequently are very hard to secure and, at best, things are difficult to place into yearly compartments because much exploration these days is of necessity on a long-range basis and the fruits of such enterprise are not in any way related to given time intervals.



Flotation practices were under intensive study during the year

# Mineral Dressing in 1955

# Intensified Research in Beneficiation Techniques Was the Most Important Development in Ore Concentration

By T. M. MORRIS

Professor of Metallurgical Engineering Missouri School of Mines and Metallurgy

THE past year has not witnessed any unusual events taking place in the field of mineral dressing. There were, however, several interesting descriptions of plant practice reported in various journals as well as results of research investigations.

#### **Plant Practice**

Flotation of molybdenite at the Morenci Concentrator was discussed by J. E. Papin. The two usual means for recovering molybdenite from copper concentrate were not applicable to Morenci concentrates. However, it was determined that copper and iron sulfides could be depressed by the use of either water soluble oxidizing agents or by the use of soluble sulfides. Pilot plant work demonstrated that the use of soluble sulfides was more feasible. No plant control was found to be suitable since the small amount of molybdenite in the copper

concentrate was not visually apparent when floated from the copper. Ferrocyanide and sodium cyanide proved to be effective depressants for copper and iron sulfides and the molybdenite was visually apparent when it floated.

W. E. Messner reported that in making a high grade silica sand by flotation, it was found that when the sand was scrubbed at high percent solids, the iron stains on the quartz were removed and a high grade silica sand was produced, with good recovery. Scrubbing raised recovery from 60 percent to 95 percent.

Development of metallurgical practice at Tsumeb was described by J. P. Ratledge, J. N. Ong, and J. H. Boyce. The metallurgical difficulties presented by this ore were such that many companies did not care to exploit the deposit. In 1947, the Tsumeb Corp. Ltd., South West Africa started to treat the old dumps. In March 1948 the new concentrator started to oper-

ate. The ore contains lead, zinc, and copper sulfides with lead in majority. A successful flowsheet for sulfide flotation was developed, and also a flowsheet for the treatment of the oxidized dump ore was developed. Since 1954 germanium concentrate has been floated from the bulk copper lead concentrate.

Mining and concentrating spodumene in the Black Hills of South Dakota was described by G. A. Munson and F. F. Clarke. Lithium minerals are difficult to beneficiate and Lithium Corp. of America Inc. uses three different methods of concentration: (1) hand sorting, (2) heavy media separation, (3) froth flotation. Heavy media separation is unique in that the pegmatite minerals do not differ much in specific gravity. Fer-

#### About the Author

The technical education of T. M. MOR-RIS was in the field of mineral dressing. After working for The Anaconda Co. for five years as a research engineer and spending two years in the Navy, Dr. Morris did work in metallurgical engineering at the School of Mines and Metallurgy in Rolla, Mo. He is there now as professor of metallurgical engineering. He has published several papers and has done consulting work for various mining companies.



Southwest Experiment Station, Boulder City, Colo., where Bureau of Mines person nel conduct pilot plant research on ore recovery

rosilicon plus some magnetite is the solid used in the medium. Flotation involves desliming, caustic blunging and using an anionic fatty acid as the collector.

P. H. Ensign discussed the test work conducted at the remodeled Magna and Arthur Mills and pointed out the reasons for the selection of certain flotation machines as well as reporting the performance of these machines.

Reserve Mining Co. has successfully produced the first taconite pellets at its E. W. Davis Works at Silver Bay, Minn. When the plant is completed in 1956 the full capacity from 12 units should be 3,375,000 tons of pellets per year, which is quite a few pellets.

#### Research Investigations

At Allis-Chalmers, Will Mitchell, C. L. Sollenberger, T. G. Kirkland, and B. H. Bergstrom investigated some of the variables in rod milling. The technique of variance analysis was used to evaluate the data obtained from use of a 39-in. by 4-ft mill. For a reduction ratio of about 16, the efficiency of the two mills was almost equal. At lower reduction ratios the overflow mill was more efficient and at higher reduction ratios the end peripheral discharge mill operated most efficiently at a reduction ratio of about 10, at a feed rate of 5000 lb per hour, whereas the end peripheral discharge mill operated most efficiently at a reduction ratio of 25 to 30 and at a feed rate of about 3000 lb per hour. At these reduction ratios and respective feed rates, practically the same work index is shown.

Ultrasonic vibrations were used to emulsify flotation collectors in water, and S. C. Sun, L. Y. Tu, and E. Acgerman studied the effect of time and intensity upon emulsification. Ultrasonically emulsified collectors gave better flotation results than col-

lectors which had not been so emulsified.

Quartz flotation with anionic collectors was studied by A. M. Gaudin and D. W. Fuerstenau using the streaming potential technique. They determined that quartz is negatively charged in pure water, and that hydroxyl and hydrogen ions appear to function as potential determining ions in water. The pH of the solution will affect the absorption of all other ions by quartz. Sodium ions function as surface inactive counter ions, while barium and aluminum ions function as counter ions and also are attracted to the surface by chemical forces. In the presence of an activator, laurate ions are associated with chemisorbed barium ions at the Stern layer.

Quartz flotation with cationic collectors was studied by P. D. de Bruyn.

Radioactive Carbon-labeled dodecylammonium acetate was used in an equilibrium study of the adsorption onto ground quartz of the collector from solutions below the critical concentration of micelle formation. The effect of pH upon adsorption of collector was studied and was found to be critical.

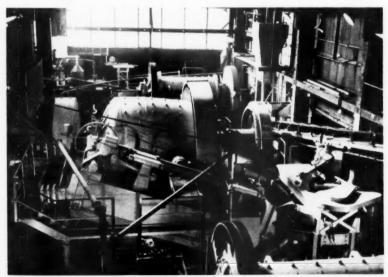
M. M. Fine and E. J. Hang studied the possibility of recovering oxidized lead mineral. The deposit contains oxidized lead in very fine form together with large quantities of sticky red clay. Gravity concentration of a deslimed sample gave satisfactory grade but low recovery. The ore was not amenable to flotation after sulfidization because of its slimy nature. Tests showed that after desliming recovery was not as good as that attained by gravity concentration, although grade was very good. Flotation of deslimed pulp using tall oil and fuel oil plus sodium silicate to depress the iron oxide gave good grade and better recovery than when sulfidization was practiced.

#### **Crushing and Grinding**

The principle of operation of the Aerofall Mill has been described previously. Much interest is centered on the results obtained with his mill in plant practice. Not too much of this information is as yet available, but this type of combination crushing-grinding unit is being used on asbestos ore, iron ore, gold ore and also on ferro silicon, quartzite and metallurgical slags and linings.

Harlowe Hardinge discussed the experiences that the Hardinge Co. has had in trying to make rock grind itself. He warns of the pitfalls that may be encountered.

Impact crushers as secondary crush-



Research engineers worked constantly to increase the efficiencies of all types of mills



Jones & Laughlin's Star Lake operation involves extensive and highly exacting mineral dressing processes which include fine grinding and magnetic separation of iron ore

ers are being more widely used than previously on moderately abrasive rock. E. Puffe described the variables affecting impact crushing and illustrated where and when an impact crusher can be used to advantage.

#### Classification

L. J. Erck described grinding and classification at the Humboldt mill. The experience gained with rod mills and ball mills is given. Pilot plant testing revealed that the Hydroscillator gave a wider spread between size of silica and size of iron oxide particles in the overflow than obtained for the conventional type of classifier.

A very interesting modification of a conventional hydraulic classifier was developed at the American Chrome Co. operation in Montana. Close classification before tabling is practiced to separate chromite and gangue. Since the specific gravity of the chromite varies from 4.1 to 4.4, and the specific gravity of the gangue varies between 3.1 and 3.5, extremely efficient table operation is required. Grade of concentrate is 39 percent Cr<sub>2</sub>O<sub>3</sub>, with 84 percent recovery. The

unique feature of the classifier used is that water is added to the teeter column to maintain density, and surges of spigot discharge are prevented by fixing the frequency with which the spigot discharge opens and closes.

#### **Operating Practices**

G. A. Vissac described the use of a modern feldspar jig in coal preparation. An artificial bed made up of pieces of feldspar is useful for cleaning fine sizes of coal. The jig can efficiently treat coal between \(^3\)k in. and \(^1\)k mm.

The handling of difficult flotation froths was described by W. H. Reck. Various types of equipment used for handling flotation froths were listed, and advantages and disadvantages of each type were discussed.

The problem of choosing the correct type of ore feeder was discussed by O. W. Walvoord, on the basis of ore characteristics, feeder functions and cost.

The use of synthetic flocculants is rather recent and startling changes in settling characteristics have been achieved. D. J. Pye discussed the use of synthetic flocculants by giving case histories of successful applications.

Heavy density flowsheets were described by R. H. Lowe. It was emphasized that the trend is away from non-magnetic medium to magnetic medium, due mainly to the ease of cleaning magnetic medium and the high recoveries obtained by magnetic separators.

#### General

The mill man is always trying to devise controls to aid him. A very interesting method of fast analysis for better metallurgical control was described by Kinnunen and Wennerstrand (Finland). They describe a method for analyzing ores, concentrates, and tailings for calcium, magnesium, zinc, nickel, cobalt, iron, aluminum, copper, cadmium, lead, and mercury—all in 30 minutes. Masking agents are used to permit successive titrations.

R. S. Shoemaker and D. L. Harris described the quantitative use of X-Ray diffraction for analysis of iron oxides. Chemical analysis does not provide a means of differentiating between hematite and gothite. The physical characteristics of these two minerals are different and therefore it is important to analyze for each in beneficiation tests. X-Ray diffraction has been used successfully to quantitatively distinguish these minerals.

At the Geneva meeting 25 to 30 papers were concerned with milling and the precipitation of uranium. Much information that was previously classified was made available, mainly by the Union of South Africa, Canada, and the U. S. The Soviet bloc did not release uranium milling data.

While there have not been any spectacular achievements in mineral dressing during the past year, we have seen the application of mineral dressing operations to other fields. The chemical industry and the ceramic industry are becoming more and more interested in beneficiation of their raw materials. In all probability this trend will continue.



Classifiers of all types are being tried



A continuous mining operation of the J. R. Simplot Co. 30 miles north of Pocatello, Idaho

# Phosphate

### Strikes in Florida Curtailed Domestic Production, But Otherwise Mining Activities Have Proceeded at a Rapid Pace

By G. DONALD EMIGH

Director of Mining Monsanto Chemical Co.

DURING 1955 there were produced about 28,000,000 long tons of highgrade phosphate ore and concentrates throughout the world. Breakdown by countries is shown in Table I.

World production would have been greater had it not been for a strike of several months' duration in the Florida fields and political troubles in French North Africa. Supplies of rock were ample for requirements because of large stockpiles called upon to fill the deficiency in production.

World production was higher in 1955 than it was in 1954 by about four percent. U. S. production was probably slightly under 1954 because of the Florida strike.

There are three phosphate mining districts in the U. S.—Florida, Tennessee, and the western states of Montana, Idaho, Wyoming, and Utah.

In the Florida field all tonnages reported here are of concentrates produced by washing and flotation plants; in Tennessee the majority of tonnage is washed; in the western states most tonnage is used directly without beneficiation. Tonnage figures used here are therefore either concentrates or ore used without beneficiation. Long tons are used throughout.

In Florida the figure for actual tons mined is about 300 percent greater than the tons reported here, in Tennessee about 50 percent greater, and in the western states less than 10 percent greater.

There are two general usages for phosphate rock—fertilizer and industrial chemicals. Fertilizer can be divided into that processed before use and that used directly on the soil. An approximate breakdown of disposition of phosphate rock produced in the U. S. in 1955 is as follows:

- 1) Industrial chemicals produced by electric furnaces ...... 19%
- 2) Industrial chemicals produced by wet-acid processes ................. 3%

The above list refers only to tonnages of raw material. The actual quantity of phosphorus going into fertilizers is higher than these figures because the electric furnace industry is using lower grade rock.

#### Florida

Phosphate operations were interrupted in Florida for most companies by a strike of the United Chemical Workers Union which started June 1. The last strike settlement was on October 1. Swift & Co. and Davison Chemical Co. were not affected.

In spite of the strike delay, Florida mines produced close to 9,500,000 tons of rock (concentrates)—about 1,030,-000 tons below 1954. Over 98 percent of production was from the pebble

#### TABLE I

|         |               | Tons           | Percent<br>of Total |
|---------|---------------|----------------|---------------------|
| United  | States        | <br>13,300,000 | 48                  |
| North   | Africa        | <br>8,000,000  | 29                  |
| Russia  | ************* | <br>3,700,000  | 13                  |
| Pacific | Islands       | <br>2,300,000  | 8                   |
|         | der           | 500,000        | 2                   |
|         |               | <br>           |                     |

field of Hillsborough and Polk Counties, with the balance from the hard rock field of Marion County. During the strike, shipments continued from stockpiles, which were reduced over 1,000,000 tons.

Armour Fertilizer Works began production from their new mining and beneficiation operation in September. For some time previous to this operation, the company had been purchasing

rock from other producers in the field. Mining equipment consists of one 770-B Bucyrus-Erie dragline with a 20-yd bucket and a 180-W Bucyrus-Erie dragline with a 6-yd bucket.

Davison Chemical Co. installed a new system to remove and stock overburden using two  $3\frac{1}{2}$ -yd draglines, 100-ft feeder conveyors, and a 1200-ft conveyor. Up to 20 ft of overburden is being removed. The company's mining and fertilizer plant operation operated normally during the year.

American Cyanamid Co.'s Saddle Creek Mine is expected to be exhausted by early 1957, after which the plant will be moved to their Orange Park Mine, located northeast of Lakeland. Except for the strike, mining operations in 1955 continued normally.

The American Agricultural Chemical Co. began operation of their second electric furnace producing elemental phosphorus on December 5, 1955. The new furnace has a 50 percent larger capacity than the older one. Early in 1956 the company plans on producing expanded slag to be used as lightweight concrete aggregate. The company operates mines and fertilizer plant, and operations were carried on normally except for the strike.

Virginia-Carolina Chemical Corp. improved its sulfuric acid plant used in connection with their fertilizer plant. The company also built a new grinding plant which included the addition of two Raymond mills. Mining and plant operations were normal for the year except for the strike.

Coronet Phosphate Co. (Division of Smith-Douglass Co., Inc) and Swift & Co. continued operations normally. The same was true for the Kible-Camp Enterprises operation in the hard rock field near Dunnellon.

Several companies not operating in the field carried on prospecting programs on pebble phosphate and the overlying aluminum phosphate (wavellite). Among these companies are American Metals Co. and Spencer Chemical Co.

During 1955 there developed a considerable truck haulage of rock from the pebble field to U. S. Phosphoric Products (Tennessee Corp.) fertilizer operations at Tampa. Several hundred thousand tons were moved in this manner. The future will likely see a growth in truck haulage in the general field.

Several companies produced uranium salts from fertilizer plant acid liquors.

In August TVA announced purchase of 1040 acres of phosphate land located in the hard rock field of Citrus County. TVA has been prospecting for several years in the general area.

#### Tennessee

There were no particular new developments in the Tennessee field. This field is in central Tennessee and largely covered by Davidson, Williamson, Maury, Giles, Wayne, Lewis, Perry, Hickman and Sumner Counties. Most production centers in and around Maury County.

There were produced during 1955 about 1,650,000 tons of high-grade and washed ore. Less than five percent of this production came from the white, blue, and brown (Leepers formation) rock in Perry and Hickman Counties. The rest was from the residual "brown" rock from the Bigby formation.

More than 80 percent of the phosphate was used in the production of elemental phosphorus in the electric furnace operations of Victor Chemical Works at Mount Pleasant, and Shea Chemical Co. and Monsanto Chemical Co. at Columbia.

International Minerals & Chemical

G. DONALD EMIGH has been with Monsan'o Chemical Co. in their phosphate operations since 1949. The first two years of this work involved exploration and prospecting evaluation of their



phosphate resources in the Phosphoria formation in Montana, Idaho, Wyoming and Utah. The next two years were taken up as production superintendent of the large electric furnace operation at Soda Springs, Idaho, where elemental phosphorus is produced. For the last three years Mr. Emigh has been director of mining for Monsanto with the chief responsibility for mining activities in Tennessee and Idaho.

Corp. continued its mining and beneficiation operations at Wales and Mount Pleasant. In addition to producing high-grade rock, the company also produces ground rock at Wales.

Virginia-Carolina Chemical Corp. operated its mining, washing, ground rock, and fertilizer operations near Mount Pleasant.

Armour Fertilizer Works continued its mining, washing, and fertilizer operations near Columbia.

Victor Chemical Works, with their mining operations, washing plant (old Hoover-Mason plant), and electric furnace plant near Mount Pleasant, continued operations during the year.

Monsanto Chemical Co. operated its mining, washing, and electric furnace operation near Columbia.

Shea Chemical Co. operated its electric furnace plant at Columbia. A second furnace was under construction during the year.

Mine Equipment Co. operated a mining and washing operation near Columbia.

Companies engaged primarily in ground rock production are Ruhm Phosphate & Chemical Co. at Columbia, and in Hickman County the following: M. C. Boyle Phosphate Co., Highland Mining Co., and Owens Agricultural Phosphate Co.

TVA mined near Columbia and shipped the ore to its electric furnace operation at Wilsom Dam, Ala. Furnace feed is a mixture of Tennessee and Florida rock. The Godwin ore beneficiation plant near Columbia, which has not operated for some time, was offered for public bid by TVA



Drying plant at the Noralyn operations of International Minerals and Chemical Corp. in Florida



View of The Gay Mine of J. R. Simplot Co. shows shop and campsite in upper right and three pits center from top to bottom

and sold to International Minerals & Chemical Corp. in June.

Edwards mining and milling operation on white rock in Perry County operated in 1955.

#### West

There were produced during 1955 in the States of Montana, Idaho, Wyoming, and Utah about 2,150,000 tons of concentrates and directly usable ore. About two-thirds of this amount was produced in Idaho. Ore is from the Phosphoria formation.

As in the other U. S. producing areas of Florida and Tennessee, production is used in fertilizers, electric furnaces making phosphorus, and ground rock for direct soil application. About half the western tonnage went into electric furnaces and most of the remainder into fertilizers other than ground rock.

Montana Phosphate Products Co. worked its underground mines near Garrison, Mont. For the first time the company also commenced strip mining operations at its Anderson Mine. The company built 4.7 miles of new track connecting with a new portal south of the Anderson Mine shaft. From the new portal a crosscut is being driven east several thousand feet to intersect the phosphate bed. This level will be near in elevation to the bottom of the Anderson shaft and will facilitate mining operations by eliminating water pumping and ore-hoisting. In addition to their main operation at the Anderson Mine, the company operates two other underground mines in the area-the Gravely and Lake Mines. All production of Montana Phosphate Products Co. goes into processed fertilizer.

The Relyea Mine, operated by George Relyea and located in the Garrison district, continued operations as usual.

Victor Chemical Works, with an electric furnace plant producing phos-

phorus at Silver Bow near Butte, Mont., continued operation during the year. Ore is mined from the Maiden Rock and Canyon Creek underground mines, located about 30 miles south of the plant. The starting of a new ore-washing operation at the furnace plant early in the year permitted the mines to improve efficiency by mining greater widths.

J. R. Simplot Co., Boise, Idaho, with a fertilizer plant at Pocatello, Idaho, and their Gay Mine, located 30 miles to the north, continued operations throughout the year. Mining is by open-pit methods. Low-grade ore is used by Westvaco's electric furnace plant near Pocatello, and high-grade ore is used by the company's own fertilizer plant. During the summer the company carried on prospecting and development activities at its new Centennial Mountain property, located on the Idaho-Montana boundary about 30 miles east of Monida, Mont., and plans to start shipping high-grade rock by mid-1956.

Westvaco Mineral Products Divi-

sion of Food Machinery & Chemical Corp. operated its electric furnace plant, producing phosphorus, near Pocatello, Idaho. Ore is obtained from the Gay Mine of J. R. Simplot.

Monsanto Chemical Co. operated its electric furnace plant at Soda Springs, Idaho, with open-pit mining operations at Ballard Mine, 16 miles north of the plant.

The Anaconda Co.'s Conda Mine, located six miles north of Soda Springs, Idaho, continued both underground and surface mining. Part of the ore is washed. Concentrates and high-grade ore are sent to the company's fertilizer plant at Anaconda, Mont.

J. A. Terteling & Sons, with properties northeast of Soda Springs, Idaho, did some stripping and mining.

Central Farmers Fertilizer Co., with property in Georgetown Canyon, east of Georgetown, Idaho, built and operated a pilot beneficiation plant near Georgetown, Idaho. No work was done on the mining property during 1955. The company announced plans to start building an electric furnace plant in 1956 for the purpose of producing calcium metaphosphate.

San Francisco Chemical Co., Montpelier, Idaho, operated its surface Waterloo Mine near Montpelier, its surface Leefe Mine near Sage Junction, Wyo., its underground Arikaree and Emma Mines in the Crawford Mountains near Randolph, Utah, and its new underground mine in the Dingle-Hot Springs area south of Montpelier, Idaho. Much of the work to date underground has been development in nature, with crosscuts, winzes, drifts, and raises. The company produces ground rock at Montpelier, Idaho, for direct soil application. At its Leefe Mine, some of the mined product is upgraded by a dry beneficiation plant. The company furnishes ore to fertilizer producers, among them being Western Fertilizers, Inc., at Garfield, Utah, and Stauffer Chemical Co. in California.



The outcrop of this Montana phosphate deposit is immediately above the snow in the middle foreground



Castro Chrome Mine near San Luis Obispo, Calif.

# **Strategic Metals**

Improved Government Minerals Policy Is Required for Survival

By S. H. WILLISTON

Vice-President Cordero Mining Co.

ONCE more the domestic strategic metal industries face a shutdown. In spite of the fact that appropriations for defense total almost 35 billion dollars annually, there seems to be little interest in Washington in maintaining production of those metals necessary to build the munitions of war.

Not long ago the Navy Department reluctantly admitted that the Russians had something over 450 submarines, and the papers, for the last year, have been filled with the accomplishments of our own atomic-driven submarines. When we recall that it is doubtful that the Germans ever had as many as 200 submarines in operation at one time, there is little doubt as to what the effect of a fleet more than twice as large would have on overseas or coastal shipping. Since it is reasonable to assume that the Russian submarine fleet will soon be driven, at least in part, by atomic power, it is now a certainty that in time of active warfare no bulk supply of strategic metals will be available by ocean routes.

Both President Eisenhower and his Cabinet Committee have expressed a desire for a healthy mining industry which could act as a mobilization base in times of emergency but, to date, no Administrative policies have been put into effect which would meet that goal. Neither does there seem to be much promise that any such policy will be put into effect before the strategic metals industries shut down.

#### Tungsten

The General Services Administration has been purchasing domestic tungsten at a price of \$63 a unit and theoretically the program was intended to extend to 1958. Actually, the money available for this purchase will have been expended by early summer. The tungsten industry, almost without exception, faces a complete shutdown at that time.

While the world price of tungsten plus the United States duty has been swinging back and forth between \$40 and \$45 a unit, the industry feels certain that if additional United States supplies were forced on this market there would undoubtedly be a material decline in price. Even if there were none, few, if any, domestic



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tungsten mines could maintain their normal exploration and development work and show a profit at this figure. There is a somewhat amusing corollary attached to this problem. If the domestic industry shuts down then there must be a reappraising of our military stockpiles, and without a domestic industry, in all probability, the goals of the stockpiles must be increased. If, on the other hand, the industry is maintained on an active producing basis then the present stockpiles are probably too high.

It is interesting to note that industry information indicates that the Defense Department was instructed in 1951 to design "around" tungsten



G.S.A. chrome-buying depot at Grants Pass, Ore.

because of the extremely short supply. Now, when tungsten is in ample, if not over-supply, the Defense Department is still designing around tungsten using as substitutes less satisfactory materials because the instructions of five years ago are unchanged.

In 1954 domestic production of tungsten totaled some 13,800 short tons of 60 percent WO<sub>3</sub>. For the full year of 1955 it is estimated that production will be about 14,500 tons, or an increase of 10 percent. Consumption, in 1954 was only a little over 4200 tons, while the estimated consumption for 1955 is close to 8500 tons, or an increase of almost exactly 100 percent.

Insofar as imports are concerned. the figures for the last quarter of 1955 are not available but if the rates of the earlier part of the year are continued it would appear that foreign material available has decreased by some 20 percent. In spite of the fact that consumption is up and rising, that imports are down and falling, the domestic industry will probably drop below its 1950 low within a relatively few months unless Washington takes fast and favorable action.

#### Mercury

The General Services Administration has instructions to buy mercury at \$225 a flask until December 31, 1957. In the year-and-a-half that this program has been in effect they have purchased five flasks. This sale was made at a loss to make sure that the program could not be cancelled. The program was put into effect when the price of mercury was slightly below \$300 with the expectation that it would increase production and decrease prices. In neither case was the assumption correct. Quicksilver production in 1954 was 18,500 flasks. Industry doubts that the 1955 figure

will be as high. There have been a few additional quicksilver plants put into operation within the last year but the production from these additional plants has not been sufficient to offset the normal decline in the older mines. Since only two years remain of the program it is now too late to find, develop and equip a mercury property, no matter how promising, and pay off on the investment before the program terminates. Insofar as 1956 is concerned, the industry estimates little if any increase in production and most operations are planning to have their available ore out of the ground by the time the program terminates in late 1957.

Insofar as foreign production is concerned, both Italy and Spain have installed the newest and latest types of furnace equipment, purchased in the United States from proceeds of sales to the United States Government. Domestic industry, on the other hand, except for the purchase

program referred to above, has been unable to sell or even bid on Government purchases since 1943.

#### Antimony

The only mining operation whose principal production was antimony closed in 1952. At the present time there are no mines operating in the country for antimony only. The United States supply comes primarily from Mexico, Bolivia and Africa. The only antimony produced in the United States is a by-product from silver-lead ores in Idaho. Here the antimony is removed, probably at a loss, to avoid smelter penalties. This domestic antimony makes up approximately six percent of the United States peace time requirements and something less than two percent of probable war time requirements. The Idaho antimony deposits are the largest domestic reserves, with the balance of the proven domestic supplies in one property in California, but neither mine, under high domestic costs, could hope to operate at much less than double the present market

#### Chrome

At the present time the bulk of American chrome supply comes from Africa and Turkey. The political situation in Africa is not good, and the location of the Turkish supply lends considerable doubt as to its availability in emergency. The high grade chrome industry in Oregon and Washington is selling its production to the General Services Administration and can continue to do so until June of 1957. The production of domestic high grade chrome in 1950 was negligible. The highest rate of production of close to 40,000 tons a year has been reached and production is now slowly tapering off since exploration and development work has



Idaho tungsten mine preparing to close

been terminated. Time is too short to be sure of mining any newly developed ore at this late date. The high country chrome mines of Northern California and Southern Oregon will have to wind up their operations not much later than October 1956. A few of the chrome operations in Central and Southern California will be able to operate through the winter. If there is to be a domestic chrome industry action will have to be taken in the present session of Congress, and the industry is becoming increasingly pessimistic about any favorable action from Washington. In the meantime, word comes from Africa that there are plans for installing ferro-chrome plants on that Continent and there are increasing possibilities that we will lose not only the chrome industry but the ferro-chrome manufacturing operations as well.

#### Manganese

The manganese requirements of the United States steel industry have been furnished about 10 percent by domestic production and 90 percent



The future of this California quicksilver operation is uncertain after 1957

by imports. A very considerable proportion of those imports have been coming from India, certainly a doubtful source in times of emergency. The Bureau of Mines' statistics indi-

cate that since 1950, when our military stockpiles were negligible, there has been a surplus of imports over consumption of some 31/2 million tons. If this is an approximate representation of our military stockpiles then we should have almost two years' supply available in the event of an emergency. There would be absolutely no possibility of developing a domestic supply of two million tons a year within a period of two years regardless of whether we had the available reserves or not. In the meantime, the General Services Administration purchase program for Arizona and New Mexico has been terminated, and the available quota at the Montana depot will probably not last much longer. The car lot limitation of 10,000 tons per producer per year makes scale manganese operations in the United States impossible. When we realize that the cost of the manganese ore in a ton of steel has a value of only 75 cents, and when we further realize that this is equivalent to 11/2 cents per hour increase in the steel worker's wage structure, then we become reasonably sure that the Administrative agencies in Washington not only are not interested in domestic manganese but probably never have been.

The attached pictures show a few of the mines of the Western States engaged in the production of strategic metals which have closed, are closing, or expect to close within the

next two years.



This antimony producer in Idaho is now idle



Pioneer tungsten operation that may face extinction





Roof falls accounted for 65 percent of fatal injuries in coal mines during the year

### Mining Safety In 1955

Falls of Roof Continue to Be Number One Killer. Two Campaigns to Reduce Them Show Different Results

#### By ARTHUR BRADBURY

Assistant to Manager Coal Properties Inland Steel Co.

UPON reviewing the safety progress in the mining industry for the year 1955, the conclusions reached are varied and somewhat discouraging.

The production of bituminous coal followed the general trend of business in 1955 and showed a substantial gain over the low tonnage of the previous year. Tentative figures indicate that this increase will reach 73,000,000 tons, or an 18 percent improvement over the 392,000,000 tons produced in 1954.

In the bituminous field, safety kept pace with production. A total of 350 men were killed representing an increase of 17 when compared with the 1954 fatalities. The accompanying table giving the fatal accident rates indicates little improvement when compared with the 1954 results. While the final figures involving non-fatal injuries are not available, reliable estimates show that a slight decrease in the frequency rate per million manhours can be expected.

In the anthracite field, production lagged approximately seven percent

behind that of the previous year, while the number of fatal accidents decreased only two resulting in an increase in the frequency rate from 1.24 to 1.49. The latest available records on non-fatal injuries also show an increase in the frequency rate from 70.96 in 1954 to 78.54 in 1955.

The usual yearly pattern of accident causes once more prevailed with roof falls being the Number One killer, accounting for 210 or 56 percent of the fatalities, and haulage in second place with 81 fatal accidents, or 21 per cent of the total of 378 for the first 11 months of 1955.

#### No Major Disasters

The most pleasing aspect of coal mine safety during 1955 was its freedom from major disasters, accidents resulting in five or more deaths. Possibly this commendable achievement can be partly attributed to the shock created by the disastrous explosion which occurred in November 1954 at the Jamison No. 9 Mine. This sudden

unexpected disaster, occurring in a modern, well-managed, apparently safe mine, resulted in a stringent review of ventilation, rock dusting and inspection practices by the State and Federal agencies concerned and by the coal companies themselves. The industry is watchfully awaiting the completion of the investigation and release of the report disclosing the cause of this accident so that similar ones can be prevented in the future.

While some jubilation might be expected and justified by a disaster-free year in the coal industry, obvious warning signals should be heeded. A number of gas ignitions have been investigated by inspectors of the United States Bureau of Mines and State Mining Departments, which should serve as an urgent warning. These comparatively harmless incidents can, with little change in the surrounding circumstances, develop into overwhelming disasters.

#### **Safety Activities Continued**

Even though no appreciable gains in the field of mine safety have been produced during the year just ended, efforts and activities were increased rather than relaxed. Included in these activities was a nation-wide campaign against accidents from falls of roof, ribs and coal. Safety education among workers and officials was intensified and research went forward with encouraging results.

Among other developments, the effectiveness of roof bolting was improved by the introduction of the compression pad. Experiments and tests were conducted in new methods

of rock dusting.

The U. S. Bureau of Mines, working with manufacturers of conveyor belts, has made great progress in producing fire-resistant conveyor belts. A schedule has been set up authorizing tests for permissibility for underground use, which should go far towards preventing dangerous belt fires.

In a further effort to reduce the possibility of mine explosions and fires, the U. S. Bureau of Mines has revised Schedule 2-E covering the testing of electric motor driven mine equipment, junction boxes and other accessory equipment. The new revised schedule, designated as Schedule 2-F, also regulates the maintenance of machine frames at ground potential. Several kinds of devices to accomplish this have been produced during the past year.

An analysis of a series of haulage accidents was made by the Engineering Committee of the Coal Mining Section of the National Safety Council. This committee, working with manufacturers of mine locomotives, introduced a set of "Safety Specifications for Locomotives in Coal Mines." These specifications are recommended for incorporation in mine locomotive design and construction and should make a valuable contribution to the prevention of haulage accidents in the future.

#### Roof Fall Prevention Campaign

For many years, roof fall fatalities have amounted to approximately 50 percent of the annual total, and in some years this figure has gone as high as 65 percent. In addition to being the principal cause of all coal mine accidental deaths, about one-fourth of the serious non-fatal injuries also occur from falls of roof

year after year. These figures show that any substantial improvement in the accident record can be best accomplished by attacking this principal source of mine fatalities. Great progress has been made in reducing accidents from all sources, but over the years the industry has not been able to make a substantial reduction in the percentage of roof fall accidents.

A number of men connected with the coal industry considered that the most effective means of reducing accidents from falls of roof would be a united, intensive program on a national scale. Accordingly, a group of men, seriously concerned with the problem, met in Washington, D. C., during November 1954, for the purpose of initiating plans for a national campaign to reduce the incidence of fatalities from falls of roof, rib and face during the year 1955.

Representatives of organizations identified with the coal mining industry attended this meeting, including men from the various coal operators' associations, United Mine Workers of America, State Mining Departments, U. S. Bureau of Mines, national, state and local mining institutes and coal mine operators. A committee was appointed and given the necessary authority to carry on the program, and an active campaign was started at the beginning of the year.

Promotional material was supplied and distributed in the form of posters, stickers and "decals" for miners' caps, stickers for auto bumpers and windshields, safety reminders placed in workmen's pay envelopes, scripts for radio addresses, and wire recordings. Articles giving publicity to the campaign were published in the mining magazines and in newspapers serving the coal mining regions. Considerable help was given through timely articles

ARTHUR BRADBURY received his mining education and early mining experience in England. After coming to the United S ales in his early 20's, he was employed in the coal mines of Southern



Illinois in various capacities having to do with mechanical mining. In 1934 he was appointed superintendent of the State Mine Rescue Station at Belleville, Ill. He joined Inland Steel Co., Wheelwright. Ky.. as mine inspector early in 1941 and was promoted to safety director in 1942. He now holds the position of assistant to manager of coal properties while still retaining charge of the safety program at Wheelwright.

and editorials in the trade, union and company magazines. Articles, memorandums and news letters were published and distributed by the various State Mining Departments, the National Safety Council and compensation insurance companies. Appropriate addresses were given before various gatherings of coal mining men by members of the general campaign committee and others. Despite these actions and the sincere efforts of safety men, foremen and mine workers, the results have not been as good as expected. Latest reports covering the first 11 months of 1955 show only a slightly better roof fall fatality rate for the industry of 0.54 deaths per million man-hours compared with 0.56 in 1954.

While nothing spectacular was accomplished with all the efforts put forth in this campaign, it is felt that the program was not in vain and that the groundwork has been laid for future improvement in this particular phase of accident prevention work. There is every indication that this campaign will be extended and continued.

#### **Roof Bolting**

In about eight years roof bolting as a systematic method of roof support has developed tremendously. Roof bolting has had considerable influence on coal mining methods, leading to general improvement in effectiveness and safety. Although roof fall accident records have not improved this year, the records show that few such accidents occur in roof bolted areas.

INJURY FREQUENCY RATES—COAL MINING—1951-55\*

|                  | No. o<br>Fatal | f Injuries<br>Nonfatal | Frequency<br>Fatal | Rates†<br>Sonfatal |
|------------------|----------------|------------------------|--------------------|--------------------|
| Bituminous Coal: |                |                        |                    |                    |
| 1955             | 350            | 16,540                 | 0.96               | 45.27              |
| 1954             |                | 15,460                 | 1.00               | 46.62              |
| 1953             |                | 20,112                 | 0.89               | 45.26              |
| 1952             | 449            | 23,719                 | 0.90               | 47.64              |
| 1951             | 684            | 28,081                 | 1.16               | 47.56              |
| Anthracite:      |                |                        |                    |                    |
| 1955             | 60             | 3,170                  | 1.49               | 78.54              |
| 1954             | 62             | 3,545                  | 1.24               | 70.96              |
| 1953             | 64             | 4,146                  | 0.92               | 59.85              |
| 1952             | 99             | 6,355                  | 1.05               | 66.35              |
| 1951             | 101            | 7,472                  | 0.95               | 69.94              |
| All Coal:        |                |                        |                    |                    |
| 1955             | 410            | 19,710                 | 1.01               | 48.58              |
| 1954             | 395            | 19,005                 | 1.04               | 49.81              |
| 1953             | 461            | 24,258                 | 0.90               | 47.23              |
| 1952             | 548            | 30,074                 | 0.92               | 50.66              |
| 1951             | 785            | 35,553                 | 1.13               | 50.99              |

<sup>\* 1954-55—</sup>Preliminary Data. † Per million manhours of exposure.

Successful bolting depends upon being able to make the ground itself an integral part of the support structure, and it cannot be relied on for protection or used alone under other conditions. During 1955, 430 coal mines reported their use of roof bolts; 120 underground mechanized mines used them exclusively.

The risk of failure of bolted mine roof may now be lessened by the use of a device known as a roof bolt compression pad. The U. S. Bureau of Mines, in seeking to make roof bolting installations more reliable, developed a rubber-in-steel bearing plate, and a similar device has been produced by industry, which holds promise as an effective warning device of impending failure of bolted roof.

#### **Rock Dusting**

Experience and research have demonstrated that the development of widespread coal mine explosions can be prevented by proper rock dusting of mine roadways. In highly mechanized mines with continuous mining machines working on three shifts, it is necessary to apply rock dust while men are engaged nearby. To accomplish this, without forming dense dust clouds, rock dust can be applied wet, either in the form of a premixed slurry or by mixing with water in a special nozzle. The rock dust subsequently dries and becomes fairly dispersible.

Recent studies in the U.S. Bureau of Mines' experimental coal mine and in mines of one of the larger coal producers show that rock dust applied in this manner is effective in stopping coal dust explosions. Tests were made with various mixtures applied in different ways. A premixed slurry of limestone dust and water fed from a gunite machine was suitable and dispersed little dust in the air. Limestone dust fed from a guniting machine or from a rock dusting machine, and mixed with water at the nozzle, was also applied effectively on mine surfaces. At least four lb of wetted dust were needed per linear foot of entry to cover the ribs and roof; about 80 to 85 percent adhered to the surfaces. In dry rock dusting about 30 to 35 percent adheres. The time for wetted limestone dust to dry varies with the humidity and the air flow.

#### Safety Education

Safety education among mine workers and mine officials has assumed a leading place in the continuous drive to lower accident rates. The principal activities in this field during the year 1955 centered around the U. S. Bureau of Mines Accident Prevention Training and the Joseph A. Holmes Safety Association program.

Other features which have aided in disseminating educational information were the widespread training in first aid and mine rescue and the production and display of motion pictures dealing with safe practices, which are being produced by the Bureau of Mines Film Production Section.

#### Accident Prevention Training

During the year the U.S. Bureau of Mines has devoted special efforts to promote and conduct accident prevention training among coal miners and officials. Since 1947 more emphasis has been placed on this training, and approximately 140,000 persons have completed the 20-hour course to date. The 100 percent training program was inaugurated in 1949, and more coal mining companies are now having all their employes trained than ever be-A total of 137 mines earned certificates stating that all employes had taken the accident prevention training during the past 12 months. This is more than twice the average for the previous five years.

A number of large companies completed 100 percent training programs during the year involving large numbers of men. These companies are located in Alabama, Colorado, Illinois, Indiana, Kentucky, Maryland, Ohio, Pennsylvania, Tennessee, Utah, Virginia and West Virginia. One company organized and completed the training 100 percent for an entire operating district employing some 6000 men. In most cases these programs were jointly sponsored by the Bureau of Mines, the mine workers' organization and the company.

It has been found from experience that far better results are obtained when the training is given to all the employes rather than to a part of the personnel. As one example of the value of 100 percent safety training, the U.S. Bureau of Mines cites the record of a large coal company whose total force of more than 1600 miners and supervisors recently completed the accident prevention course. Not a man was killed in a mine accident during the year training was in effect. non-fatal lost-time injuries dropped 44 percent and the injury severity rate was cut 64 percent. In another instance, a group of four mines were producing an average of only 12,000 tons of coal per lost-time accident before 100 percent safety training was completed. Then the record improved progressively until average output per lost-time accident reached 158,000

#### Joseph A. Holmes Association

The Joseph A. Holmes Association was active during the year in promoting safety. One of the main endeavors of this organization was that of maintaining interest in safety by providing suitable programs for use in

chapter and council meetings. A number of new councils and chapters were formed, and at this time there are 312 chapters and 22 councils in 13 states.

Following the usual annual custom, this Association made a number of awards based on safety performance. Medals of Honor were awarded to 14 men and Certificates of Honor to four men for the part they played in saving lives at the risk of their own. A total of 483 Certificates of Honor were awarded for outstanding safety records to coal mining, metal mining and petroleum companies and to individual employes engaged in these industries.

#### First Aid and Mine Rescue Training

Training programs in first aid and mine rescue were increased. Most coal producing states and local districts within these states held contests between teams representing numerous coal companies. This program was most suitably climaxed by the National First Aid and Mine Rescue Contest, which was held at Knoxville, Tenn., October 10-12, 1955. This contest was sponsored by the U.S. Bureau of Mines, the Joseph A. Holmes Safety Association, the National Coal Association, the United Mine Workers of America and the State Departments of Mines of the principal coal mining states. For the first time in many years teams from metal mining companies participated. A total of 54 first aid teams, nine mine rescue teams and two combination teams were entered and took part. These teams represented mines in nine different states.

#### **Miscellaneous Activities**

A great deal of money, time and effort is expended annually in attempts to create safer conditions for workers in the mines and to reduce the number of accidents. Evidence of this was prominently displayed during the past year.

The U. S. Bureau of Mines is equipped to take the lead in accident prevention work and did so in a forceful manner. Other agencies engaged in promoting safety include the Mining Departments of the various states, state and local mining institutes, the National Safety Council, operators' associations, mine workers' organizations and other groups connected with the mining industry, such as the Mine Inspectors' Institute of America.

More prominence was given to questions of safety in the pages of the mining magazines and at the annual conventions of the numerous mining organizations than ever before.

Several noteworthy developments occurred during the year which deserve mention in a safety review.

These include the retirement of J. J. Forbes from the position of director of the U. S. Bureau of Mines after 40 years in safety work. The Federal Coal Mine Safety Board of Review, in response to appeals, made several important decisions which affect safety problems. Another item was the announcement by the Bureau of Mines of changes in inspection policies, which should provide incentive to management to maintain the mines in the safest condition possible.

Gains in safety and accident prevention are becoming increasingly difficult to attain and less spectacular in scope than they were several years ago.

While the results of all the efforts to reduce accidents in coal mines did not fulfill expectations in 1955, there is ample evidence that constant attempts to create safe mining conditions and interest in safety among the men and supervisors in the mines will be rewarded. A number of companies completed the year with frequency rates of less than 10 accidents per million man-hours. Other striking examples of successful safety programs are mines having produced 6,000,000 and 7,000,000 tons of coal without a fatal accident.

These examples prove that mine accidents can be prevented and should serve as an inspiration for others during the years ahead.

U. S. Bureau of Mines in cooperation with local mining companies and other agencies. Great interest has been shown in this training, and the results are most satisfactory. Many companies have all of their employes, both underground workers and supervisors, trained in accident prevention and/or first aid. Training of this sort is designed to give better accident records in the future.

Rock bolting was expanded somewhat during 1955 as was the development of underground diesel haulage. The increased use of rock bolts has probably greatly aided the falls of ground campaign and eliminated many serious underground accidents. Diesel haulage presents many possibilities in underground mining and should prove quite successful from the safety standpoint.

The United States Public Health Service and the Public Health Department of Colorado have done considerable work relating to the health hazard in uranium mining.

Off-the-job safety programs have been organized in several mining areas with a view to making the workers more safety conscious at home and, in turn, promoting their outlook toward on-the-job safety.

### **Metal Mining Safety**

THE major safety activity in the metal mining industry during the past year was the International Falls of Ground campaign.

A great deal of work has been done in the past by individual companies in efforts to reduce the number of accidents from falls of ground. However, no concerted organized program had been attempted until the Executive Committee of the Mining Section of the National Safety Council authorized a committee to plan and carry out a national campaign. The appointed committee consisted of safety directors from various metal mining companies and associations interested in the prevention of accidents.

The committee agreed that there were two essential items needed: (1) obtaining the support of management and (2) the cooperation of the mine workers.

Special rules and suggestions were set up and the campaign swung into operation.

A total of 344 mines enlisted in the campaign. These mines agreed to furnish records of falling ground experience to the National Safety Council in return for the services of the Council. The National Safety Council prepared posters, films, publications, etc., to be distributed for use in the campaign. In addition to the services of the National Safety Council, several mining companies also produced material.

The results of the campaign are very encouraging. Final statistics for the year are not available, but the figures for the first six months of 1955 show an average reduction of 27 percent in the frequency of injuries from falls of ground as compared with the base period of 1952 through 1954.

If, during 1952, 1953 and 1954, participants had controlled injuries from falls of ground as efficiently as they did in the first six months of 1955, approximately 600 men would not

have been injured or killed. Special attention to this major hazard in the future will, therefore, pay big dividends.

Accident prevention training, first aid and mine rescue courses were promoted in the metal mining industry during 1955. This training was conducted under the direction of the

#### **Coal Preparation**

(Continued from page 99)

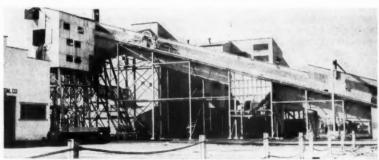
that it can be started and stopped to meet plant operational demands and that it has no moving parts in contact with hot gases. Bed temperature can be controlled to the extent that there is little or no danger of oxidization of the product being dried. This process is unique and seems to offer much to the continuing progress of coal preparation art.

#### Carbonization

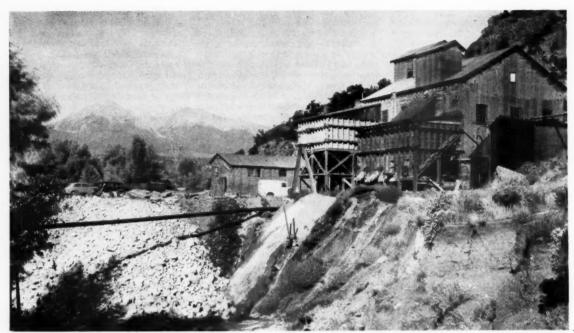
A further refinement of coal, low temperature carbonization is getting a lot of attention these days. Low temperature carbonization has been studied, proposed, completed in laboratory tests on small scale units, been conducted in full scale isolated cases and has been more or less proved a

successful profit-yielding venture. In these isolated cases, where coal is being carbonized by low temperatures, there are extenuating circumstances to make it profitable. With the experience, know-how, time and money which proponents of low temperature carbonization have expended over the past 20 or 30 years, it is quite possible that conclusions reached in 1955 might be the trigger to make many large scale operations a reality in the year com-

The foregoing observations of coal perparation in 1955 are the author's personal views as seen in his scope of preparation activities. At the incredible rate that technological knowhow is developed and reviewed in professional journals, it is virtually impossible for one individual to be aware of all developments in a field with the spread of a new and improving coal preparation art.



Over 3,500,000 tons of coal were handled at the No. 10 preparation plant of Peabody Coal Co. in 1955



Fluorspar mill of the Colorado Fluorspar Corp. near Salida, Colo.

### **Industrial Minerals**

A Busy Year in a Field Where Small Businesses Make
Big Industries

By J. L. GILLSON

Geologist
E. I. du Pont de Nemours & Co., Inc.

EACH year, as this reviewer analyzes the accomplishments and developments of the past 12 months, he finds it impossible to portray adequately in a few pages the very immensity of the efforts and achievements of the small army of men working in this broad field. The year 1955 was a peak year in nearly every line. It was the largest in construction activity, \$42 billion worth; the most automobiles were produced of which 7,225,000 cars and 950,000 trucks were sold; dividends were higher and average weekly wages set a new high at \$76.

The real "first" in industrial minerals is always "aggregates" and it is with that uninspiring but fundamental product that this review will start.

AGGREGATES—The value of sand and gravel produced exceeded \$400,000,000 and the value of stone quarried, not including that used for lime and cement, exceeded \$500,000,000. Producers of sand and gravel are in general moderate-sized companies, al-

though a few work in several cities and marketing areas in adjoining states. Many of them manufacture cement blocks and make ready-mix concrete as well as produce the raw materials. Inquiries directed to individual producers received the inevitable answer that "there was nothing newsworthy, we just kept busy." But that was the newsworthy item. Because they kept busy, \$42 billion of new construction was completed, the Ohio Turnpike was opened, the Dallas dam which will add 1,122,000 kw of capacity to the power hungry Northwest is well on its way, as are a dozen other big ones; and a total of about \$5 billion worth of highways and a host of new airports and runways were built. New airport buildings at Dallas, Fort Worth, Chicago, St. Louis, Houston, Charlotte, Jacksonville, Philadelphia, and Newark were built because these producers of aggregates "kept busy."

For the St. Lawrence Seaway, two plants in the Cornwall, Ontario, area are producing manufactured sand by



JOSEPH L. GILLSON is widely recognized as an authority on industrial minerals. His work as an economic geologist with Du Pont brings him into first-hand contact with the many commodities about which he writes.

grinding limestone and dolomite because there are no nearby sand deposits. Another gravel producer has installed Heavy Media separation near Northville, Mich., 25 miles from Detroit, to remove chert and shale which makes up about 10 percent of the deposit. The use of resistivity methods of prospecting to determine thickness of overburden at a gravel deposit in Jefferson County, Mo., was described in the February issue of Mining Engineering. The use of liquid cyclones to recover fine sand needed in bituminous paving by a California operator was described in Rock Products for August. A nonskid rock asphalt coating was developed by the Indiana Highway Department and during an 18-month test, accidents due specifically to skidding on a wet surface dropped from 66 to 2. Experimental sections of road surfacing containing rubber have been laid in several states. The rubber is added in the form of pellets about the size of erasers for pencils.

The U.S. Bureau of Mines is preparing a volume on Mineral Facts and Problems. The chapter of Sand and Gravel was issued as a preprint. It gives much general information of interest, but statistics are for 1952.

Unlike the producers of sand and gravel, most of the stone producers are multi-million dollar companies, each operating several or many quarries and produce stone for purposes other than road metal, railroad ballast and concrete aggregate. Many are units of cement companies, or steel company subsidiaries that produce fluxing stone. An outstanding example is the new quarry near Cedarville, Mich., being developed by the Michigan Limestone Division of the U. S. Steel Corp. One of the largest of the true stone companies is the New York Trap Rock Co. It now operates a fleet of 200 barges, having spent \$2,000,000 on new ones during the past 18 months. The manager of a large granite producer in Decatur, Ga., describes the following current developments: a trend to smaller diameter holes and drilling to obtain better breakage. In hard rocks these holes are drilled with percussion drills and tungsten carbide bits. Jet piercing is making progress in channel work for dimension stone, but its use for blast holes waned with the trend to smaller diameter holes. A new type of drill called "in-the-hole drill" is now on the market and is showing promise in reducing steel consumption and giving higher penetration speeds. Portable plants are being constantly improved, both in speed of set-up and in reliability. Few large fixed plants are being built now. This advantage of portable plants stems from the fact that large demands for stone have to be met temporarily in a very local area, as for the requirements of a dam, or a new highway. Progress is being made in centralization of electrical controls to reduce labor requirements. Because of the need of new deposits for temporary local operations, much more geological exploration has to be done than in the past.

ABRASIVES—A new deposit of corundum was discovered, in Mozambique, Africa, 30 miles south of Villa Pery. The crystals are recovered from the soil mantle over a feldspathic dike intruded into a gneiss. Crystals up to fist size have been recovered. An American company is financing the development.

A review of the abrasives industry in Japan is given in Mineral Trade Notes for June. There are nine producers of artificial abrasives in Japan and eight producers of abrasive cloth

and paper. Four companies produce diamond wheels and seven other types of abrasive wheels.

News of industrial diamonds will be given under the heading of diamonds.

ASBESTOS-An excellent review of the principal chrysotile asbestos deposits in the world was presented to the Canadian Institute of Mining and Metallurgy, and was given the President's gold medal. It was published in the bulletin of the Institution for October. The author, D. J. Straw, points out that the leading asbestos mines of Canada have been in almost continuous production since their discovery. Production grew from 10,000 tons in 1896 to 300,000 tons in 1930 to 973,198 in 1951. Although other countries, particularly Southern Rhodesia, have become important, Canada still accounts for 65 percent of the total world production. The Jeffrey mine of the Canadian Johns-Manville Company, Ltd., is the largest single producing mine in the world, accounting for 37 percent of the world production in 1951. Information is given about properties of the Continental and Nicolet Asbestos Mines and of those of the Asbestos Corp., Ltd. Ontario has 76 known occurrences but only the Munro mine in the Cochrance district is in production. British Columbia has one mine, the Cassiar, located about 200 air miles east of Juneau, Alaska. Africa is the second ranking asbestos producing continent, and in Southern Rhodesia the value of the mineral closely rivals that of gold. In that colony there are two principal districts; Bulawayo in which are the Shabani, Birthday and Nil Desperandum properties; and Victoria in which are the Mashaba (King and Gath mines), Shamala, Shashi, Temeraire and Darwendale properties. The geology of each of these deposits is described. In Europe, only Russia ranks as a leading world producer. Although asbestos is known to occur in Russia in four areas, most of the production comes from Bajenova (approximately latitude 58° N, Longitude 60° E). Cyprus is the second ranking asbestos producer in Europe. In South America asbestos is found in Venezuela and Colombia. Some production has been reported from Australia.

Another important geological paper on asbestos published during the year was by Riordan in *Economic Geology* for January-February. He described the origin of asbestos in ultra basic rocks.

The block-caving method employed at the Jeffrey mine in Quebec was described in Rock Products for May. The ground lends itself well to block-caving, the horizontal dimensions are 2700 by 2200 ft. The No. 1 main shaft is 1800 ft from the ore body. No. 2 shaft was started in February 1953 and sunk to 1413 ft. All blocks are caved 200 ft wide and 200 ft long.

Currently ore is being drawn from six blocks, each containing some 11/2 million tons of ore, at the rate of 2500 tpd per block. Canadian Johns-Manville opened the first unit of its new mill at the Jeffrey mine in 1954 and the second unit, now well under way, will be completed in 1956 when all treatment operations will be transferred from existing mills. Air-handling and dust-control in this mill was described by Goldfield in Mining Engineering for November. The big mill of Johnson Co., Ltd., at Black Lake, which was finished in 1953, was described in Mining World for August.

United Asbestos, a subsidiary of American Smelting and Refining Co., conducted dredging operations in connection with the drainage of Black Lake in Quebec. The 5000-tpd mill should be ready in late 1956. The total investment will be \$20,000,000.

Three companies, the Asbestos Corp., Johnson's and Bell Asbestos, are involved in a project costing \$5,500,000 to relocate surface installations at Thetford, Que., to make more ore available for mining. Asbestos Corp. has spent \$14,000,000 on a 5000-tpd mill and development of its Normandie mine. This mill will replace the present smaller mill in operation at the company' Vimy Ridge mine.

Quebec Asbestos, a subsidiary of Philip Cary Mfg. Co. of Lockland, Ohio, located a new deposit near East Broughton, known as the Carey mine and is planning to spend \$7,000,000. The deposit is 31/2 miles from the original mine of the company and is estimated to have 50,000,000 tons of ore. Golden Age mines has 11,500,000 tons of ore. Work sampling the ore body is continuing. Derogan Asbestos Co. is exploring an ore body found by magnetic surveying. Eastern Asbestos is exploring its property in Portland West township. The fiber is said to be iron free.

At the Munro mine in Ontario the shaft was bottomed at 860 ft at the end of 1955. After two more years of underground development work, the open pit will be abandoned. Production from the Munro mill amounts to about \$4,000,000 annually.

The mine of Cassiar Asbestos Corp. in the Liard Mining Division of Northern British Columbia was described by Fred Bell in Mining Congress Journal for May. The asbestos was discovered in 1949 and Cassiar Asbestos Corp. was formed in 1951. Spinning tests conducted in the winter of 1953 justified the development of the mine which took place that year and a 500-ton mill was finished in July 1954. The fiber is trucked in 100lb bags to Whitehorse, 350 miles away, of which the first 86 miles runs from the mine to the Alcan highway. From Whitehorse, the fiber is moved to Skagway, Alaska, by rail and then to Vancouver by water. Shipping costs are \$70 per ton. The power plant was increased this year to 1400 hp. In addition to the main ore deposit on McDame Mountain, another on nearby Cirque Valley shows great promise.

The asbestos deposits of Arizona were described in the U.S. Bureau of Mines Information Circular 7706. The Bear Canyon deposit in the San Carlos Indian Reservation which is one of the several producers in the Gila County area was acquired by Jack Neal and Associates of Globe. Bids for leasing of asbestos mining property on the Fort Apache Indian Reservation were opened on December 14, 1955.

Rhodesian Asbestos, Ltd., the second largest mining and milling operation in Southern Rhodesia, started late in 1954. The company is under the direction of Canadian Johns-Manville Co., Ltd., in association with British Metals Corp., Ltd., Anglo-Huronian. Ltd., Southern Minerals and Marketing, Ltd., and the Simon I. Patino interests. There are two mines under development, the Temeraire and the Shamala. Mill facilities have a capacity of 125 tph, and the annual production of fiber is 20,000 tons. Production of Rhodesian asbestos in 1954, as reported in the February Mineral Trade Notes was 87,739 tons, of which about half was shipped to the United Kingdom

In South Africa, production of all types of asbestos totaled 109,151 tons in 1954, of which 45,922 was amosite, 28,136 was Cape Blue, 19,373 Chrysotile and 15,610 was Transvaal blue.

The Amiandoes mine of the Cyprus Asbestos Mines, Ltd., produced 9200 tons of long fiber and 6109 tons of short fiber in 1954.

Production of asbestos in Australia was reviewed in the Mining Magazine for April. The only deposit providing material for asbestos cement manufacture is at Baryulgil, 52 miles northwest of Grafton, N.S.W. Good quality, long fiber asbestos is being mined at Nunyerry and at Sherlocke, in the Roebourne district of West Australia.

BARYTES-World demand and consumption are increasing. The current figure is about 2,000,000 tons of which about half is produced in the U.S. No other material meets so satisfactorily the requirements of a weighting agent in drilling muds. There is an increased use of it for giving weight to the concrete around pipelines in river crossings and swampy areas. A new use that may become substantial, is in a mixture of finely ground barite and synthetic rubber which is added to hot-mix asphalt in road construction. Barium titanite is used in ultrasonics. Barytes may become an important ingredient in concrete shields in atomic power plants. On the other hand its use in lithopone and pigments has almost evaporated, and gypsum is being substituted for it in glass.

There was a time when Tennessee,

Georgia and Missouri supplied the bulk of barytes consumed. Now the important producing states are Arkansas and Nevada. However, the reduction of car-load freight rates from inland producing points to coastal grinding plants, and an increase in ocean freights has brought the domestic producer back as major suppliers of crude rock.

The largest U. S. producers are the Baroid Division of National Lead Co. and Magnet Cove Barium Corp., a subsidiary of Dresser Industries. Magnet Cove Barium Corp. has entered Canada by acquiring the largest Canadian producer, Barymin Company's mine at Walton, Nova Scotia. This mine has averaged in excess of 200,000 tons production during the past three years. The only other Canadian producer is

This mine was purchased by the Mudd family from the Borax Consolidated, Ltd., of England. Adjacent ground has also been purchased. The bedded deposit dips at 15° and is 30 to 200 ft thick.

CERAMICS—Synthesis of diamonds became a fact in 1955 and was announced by the General Electric Co. in March 1955. The largest diamond measured  $V_{16}$  in. in longest dimension and was made by subjecting carbonaceous materials to temperatures above 5000° F at pressures in excess of 1,500,000 psi.

Special high temperature refractories and refractory coatings are in demand for nuclear energy and jet propulsion applications. Carbides, borides, and silicides are being con-



Large plant of the Pacific Coast Borax Co. in Boron, Calif.

Mountain Minerals, Ltd., with quarries at Farson and Brisco, B. C., and a processing plant at Lethbridge, Alberta.

Most of the U.S. news in barytes comes from Battle Mountain, Nev., Magnet Cove Barium Corp. is building a mill there to treat 175 tpd. Construction of a road over Mill Creek summit to the Gray Stone Barytes mine was completed in July 1955. Westvaco Mineral Products Division of the Food Machinery and Chemical Corp. has leased a property from the Glidden Co. and will ship ore to its reduction plant at Modesto, Calif.

BORAX—For the first time in several years, the mineral borax seems to have come to life. Pacific Coast Borax Co. has started an \$18,000,000 construction program to be completed in 1957. The mine at Boron, Kern County, Calif., will be converted to an open pit and a new concentrating and refining plant will be built.

A new producer will be the No. 3 shaft of the old Western Borax mine, which will be deepened to 1130 ft. sidered as promising materials for refractory coatings. Armour Research Foundation has announced a new process, solution ceramics, whereby soluble metal salts are sprayed on hot surfaces to decompose into oxides and form a hard, refractory oxide coating by thermal decomposition of the salts. Another, hot flame spray and fusion method, developed by Norton Co., gives similar types of coatings which show excellent adherence.

Alumina ceramics of high density are being used for cutting tools to replace more expensive tungsten carbide bits. The alumina bits, made of nonstrategic materials, are therefore of special interest to our Armed Forces.

Low temperature enamels to coat aluminum are getting considerable attention. They make possible the coloring of aluminum household wares and compare favorably in acid resistance with sheet steel enamels. One novel application is for scratch resistant chalk boards.

An enamel without ground coat or nickel flash has been tested successfully by Parker Rust Proof Co. and

the Frigidaire Division of General Motors Co. Called Parker pre-Namel 410, it shows that cold-rolled rimmed steel can be enameled with one coat. Lithium bearing enamels for aluminum are growing in use. Several enameledaluminum buildings are being tested at the present time. One producer foresees an annual consumption of 5,000,000 lbs of lithium carbonate for this use in a few years. The Armour Research Foundation has developed "Flame Spray Ceramics." Ceramic material is sprayed on by feeding powdered ceramic material through a simple flame gun. The process has been licensed to Continental Coatings Corp. of Chicago. The coating, which is heat and chemical resistant, consists of sintered layers of either of two stable oxides, aluminum or zirconjum A similar material developed by the Montaine Corp. is called "Flame This is a super refractory material that will bond to miscellaneous metals and to glass, and give a coating that is chip-resistant and provides electrical as well as thermal insulation. Having a slight porosity, it can absorb lubricants, thus fitting it for bearing applications.

The Emjay Maintenance Engineering Co. of Rutherford, N. J., has announced a ceramic material called "Expansolin" which will bond to iron or steel and expand and contract with

the metal.

A new ceramic material has come out of the Bureau of Mines Electrotechnical Laboratory at Norris, Tenn. A synthetic fluorine mica fused with an orthophosphoric acid makes a machinable ceramic material. The mixture is cold-formed and then fired at 900 to 1300° C (Chemical Week, 4-30-55).

CLAYS—Clay and clay products are a \$125,000,000 industry in the U. S. As such, they should command a great deal more attention than do many of the other industrial minerals of lesser gross value, such as fluorspar, phosphate, potash, talc and titanium ores which may be more glamorous than making bricks or sewer tile and mixing up bentonite or fuller's earth, but these minerals are small items, compared with the clay products!

The forthcoming book to be published by the U.S. Bureau of Mines entitled "Mineral Facts and Problems" includes a chapter on clays, a preprint of which appeared in 1955. This report brings out a number of interesting facts. The principal industrial clays are kaolin or china clay, ball clay, fire clay, bentonite, fuller's earth and miscellaneous clays. About 75 percent of all clay produced is used in manufacturing formed and fired ceramic products. Only six percent of the clay used in domestic consumption is imported. Georgia produced 71 percent and South Carolina 17 percent of the domestic kaolin production. Ninety percent of the ball clay production came from western Kentucky and western Tennessee. The only commercial domestic output of catalytic grade halloysite came from Utah. Over half of the domestic consumption of kaclin is used as a filler or coating in paper. Ball clay and fire clay are used almost exclusively by the ceramic industry. Bentonite and fuller's earth are used for clarifying and cracking petroleum products, in foundry facings, drilling muds, and numerous other non-ceramic uses. Of the 42,435,964 tons of clay products used in 1953, 18,243,673 tons went into heavy clay products, such as brick, drain tile, sewer pipe, etc.

There were a number of special news items in regard to clays in 1955. Dr. C. G. Albert, assistant director of Research, Minerals and Chemicals Corp. of America, which has become one of the largest producers of special clays in the country, and certainly the one doing the most intensive research on clay products, wrote up a study on the requirements of paper clays which was published in the October issue of

Mining Engineering.

The Anaconda Aluminum Co. believes it has a process to make alumina available from the clays of the Pacific Northwest. The company has acquired holdings of clay properties in the region and hopes to have its recovery process in use by 1957.

The Clay Minerals Committee of the National Research Council held the Fourth National Clay Conference at Pennsylvania State University Octo-

ber 10-13.

Bentonite is a most unusual material. Not only is it the colloidal material so widely used in drilling muds, but it is finding a new application in making the pellets that are prepared by the Bethlehem Steel Co. at their new Marmora iron mine in Ontario for use in their blast furnaces. Arimex Chemical Co. has started processing bentonite mined near Sanders, Ariz., in a new plant at Gallup, N. Mex. Hectorite is the name of magnesium bentonite which possesses remarkable properties. The Stanford Research Institute developed a process for benefication of a crude product. Having purified the hectorite, it was found to be an excellent material for keeping beer from becoming clouded during the chill-proofing stage. It also goes into pharmaceuticals and cosmetics, and makes a dieletric sheet called Amplifilm.

COLUMBITE AND TANTALITE—By historical precedent, columbite has been an industrial mineral since the metals industries made no claim to it. Now that columbium, or niobium as the chemists insist we call it, is becoming a very important metal for high temperature and corrosion-resistance applications, it and other columbian minerals have become metallic ores.

An excellent review of the ore min-

erals, and of European and African occurrences was given in the Mining Magazine for January. Dr. Robert Rowe of the Canadian Geological Suivey discussed the association of niobium minerals with alkaline rocks in the Canadian Mining Journal for March. Exploration in the Oka district, 30 miles west of Montreal, has been principally by the Molybdenum Corp. and by a joint effort of Headway Gold Mines and the Coulee Lead Zinc Co. The rock at Oka is a limestone affected by contact metamorphism from alkaline rocks. The Kennecott Copper Corp. has purchased a 51 percent interest in the property held by the Molybdenum Corp., and has bought a substantial block of the stock of that company. A deposit found on islands in Lake Nipissing, Ont., has been explored by Beaucage Mines, Ltd. The ore seems to be a replacement of nepheline rocks and of crystalline limestone. Placer ground containing niobium minerals in British Columbia and in Idaho has been explored. A placer 25 miles west of Spillamacheen, B. C., which resulted from the erosion of the Bugaboo spires in the Selkirk range (a place well known to mountain climbers) is being developed by the Quebec Metallurgical Industries (a Ventures subsidiary). Placers north and northeast of Boise, Idaho, have also been found on such creeks as Bear Valley, Grimes Creek, and Dismal Swamp. The deposit at Bear Valley is being worked by Porter Brothers who have a contract with the U.S. Government to supply their output of the niobium mineral, euxenite. They have built a mill at Lohman. Idaho.

At the present time the only other production of niobium is from tin placers, principally in Nigeria and the Belgian Congo, where the mineral columbite occurs as a by-product, and rock deposits in southeastern Norway, worked by A/S Norsk Bergverk which produces pyrochlore from calcite veins or lodes in nepheline syenite. Deposits at Tororo in Uganda which seem to be very large belong to Ventures, Ltd., and were described in the Mining Magazine for April. Deposits at Nkumbwa Hill, Isoka district, Northern Rhodesia; on the Kenya-Tanganyika border; in Angola; at Penda Hill in the southwest border of Tanganyika and at Katto, Northern Nigeria were all mentioned in the news in 1955. The Penda Hill area was described in Economic Geology September-October. The Mbeya Exploration Co. has been formed by N. V. Billiton Maatschappij in conjunction with the Colonial Development Co. to work these deposits.

DIAMONDS—News of activity in various diamond fields was frequently noted in the journals during the year. As usual, production statistics are always a year behind but we have a good summary of the year 1954 in Mining Magazine for November 1955. As usual, the Belgian Congo produced over 60 percent of the total number of carats, with South Africa a poor second, followed closely by the Gold Coast. The largest producer outside of Africa was Brazil which accounted for one percent of the total production of over 20,000,000 carats. Sales of industrial and gem diamonds totalled approximately £65,000,000 in 1954 as compared with £63,000,000 in 1953. Of the 1954 production 84 percent were of industrial grade; the balance gem. The industry in the Belgian Congo was described in Mineral Trade Notes for May, and a special supplement of 23 pages of the same publication was put out in June which described the Bécéka's Industrial Diamond Mining operations at Bakwanga. Diamond mining in Tanganyika at the Mwadui mine of Williamson Diamonds, Ltd., had twice the output in 1954 as compared with 1953. Activity in South West Africa was reported by Industrial Diamonds of South Africa, Ltd., on a recently discovered marine terrace at Saddle Hill North, in the Luderitz district. Kimberley West Diamond Corp., Ltd., has two concessions in South West Africa. One includes the deposits at the mouth of the Kuene River in the North, the other is near the Grootfontein-Tsumeb district.

The diamond cutting industry of Amsterdam was closed by a strike during the early part of the year.

The Panna Diamond Mines, in central India are of recent discovery and are very promising. The company is said to be negotiating with the Soviet government to develop the mines. Diamond recovery in Angola was described in the Mining World for April. During the first five months of last year, 591,958 cu meters of gravel yielded 283,618 carats of diamonds.

DIATOMACEOUS EARTH-The lowly diatom, the basis for a \$16,000,-000 business, is highly useful in filtering a great variety of chemicals; as a filler and a carrier for insecticides; as an insulating material and as a mild abrasive. The seven principal producers are Johns-Manville Corp., Lompoc, Calif.; Great Lakes Carbon Co. at Walteria, Calif.; Basalt, Nev., and Terrebonne, Ore.; Eagle Picher Co., near Reno, Nev.; Tri-O-Lite Products Co., Carlin, Nev.; Chick Bed Co., Fernley, Nev.; Kenite Corp., Quincy, Wash.; James H. Rodes Pumice Co., Espanola, N. M. Great Lakes Carbon Co. was drilling a large area in the Otis Basin, Harney County, Ore., during the summer. An excellent review of the industry was written by P. M. Rapier and published in the December issue of Engineering and Mining

DOLOMITE - Michigan Limestone Division, U. S. Steel Corp., shipped the first cargo of dolomite from its new Cedarville quarry, Chippewa County, Mich., from Port Dolomite in its new self unloading steamer "Calcite" on April 16, 1955. The quarry has an annual capacity of 3,000,000 tons. The primary crusher is in the floor of the quarry. Stone is hauled from the quarry to the port over a new railroad five miles long. At the port are secondary and tertiary crushers and screens, with a rated capacity of 1800 tph. The dock is 620 ft long. Along it runs a travelling loading shuttle which can fill a 12,000-ton boat in five hours.



This 250-ft deep fluorspar operation is typical of the small scale of many industrial minerals producers

This dolomite quarry is complementary to the same company's high calcium carbonate quarry near Rogers City, in Fresque Isle County, about 60 miles south of Port Dolomite.

In California, Kaiser Aluminum and Chemical Corp. has purchased 353 acres of dolomite property adjoining its chemicals division plant at Natividad. Dolomite calcined at Natividad is shipped to the corporation's seawater plant at Moss Landing, Calif., for processing into magnesia brick and grains.

FELDSPAR AND NEPHELINE— International Minerals and Chemical Corp is planning three new plants and has been diamond drilling extensive holdings in Connecticut, Flotation capacity at Spruce Pine has been increased 50 percent and new fine grinding equipment has been installed at Erwin, Tenn. The LeBaron-Lawyer electrostatic process has been installed at Topsham, Me. Application of electrostatic separation to the feldspar industry is not new since a Johnson separator was in operation at Spruce Pine as early as 1938 at one of the United Feldspar plants. Also at Topsham, Me., the management has installed a geiger counter which, with appropriate formulas, gives an analysis of the potash content of a sample in five minutes.

Pacific Tin Consolidated Corp. has

organized a subsidiary called the Feldspar Corp. to take over Feldspar Flotation Corp. at Spruce Pine, N. C.; Feldspar Milling Co., Burnsville, N. C.; Feldspar Corp., Erwin, N. C., and Appalachian Minerals Co., Monticello, Ga.

A new company called Spar-Mica Corp., Ltd. has been formed by Electro Refractories and Abrasives Corp. and Strategic Materials Corp of Buffalo, N. Y. This company will build a feldspar mining and processing plant near Johan Beetz which is east of Havre-St. Pierre on the north shore of the Gulf of St. Lawrence. The finished product will be shipped to Camden, N. J.

In the nepheline area at Blue Mountain, Ont., the Canadian Flint and Spar Co., a subsidiary of International Minerals and Chemical Corp. and the largest Canadian producer of feldspar, is building a mill with an initial capacity of 250 tpd. A spur line of the C.P.R. 31/2 miles long will serve this new mill. American Nepheline, Ltd., a subsidiary of Ventures, Ltd., has announced plans for spending \$2,509,-000 at its plant at Nephton, Ont., 35 miles northeast of Peterborough. new facilities will more than double the plant capacity. The C.P.R. completed a spur north from Havelock 17 miles to Nephton, at a cost of \$1,500,000.

FLUORSPAR-There was a high level of activity in the steel, aluminum and chemical industries, which use fluorspar, and the consumption of fluorspar of all grades was probably about 560,000 tons. This would be a little below the record of 586,798 tons in 1953. Domestic production was probably slightly higher than the 244,939 tons produced in 1954, but still well below the record of 331,273 tons in 1952. Imports are given as 390,000 tons but this figure includes the crude feed to the flotation plant at Wilmington, Del., operated by the St. Lawrence Corp. which when converted into concentrate probably represents only about 60 percent of the feed, and all is committed to the Government stockpile.

The quoted price of acid grade fluorspar held steady at \$47.50 per short ton, f.o.b. domestic point of production, which was down from \$60 to \$65 two years ago. Metallurgical spar was down to \$26 for the so-called 60 percent effective last year, but has been up to \$28 this year and the 70 percent effective has brought \$32. In August 1955 a stockpiling program was announced through ODM, but only very limited tonnages have been purchased, primarily because of the difficulty of determining the price to be paid.

The world production of fluorspar for the years 1945-54 was reviewed in *Mineral Trade Notes* for August. Europe exceeds North America in production with West Germany leading, followed by England, East Germany, Italy, France and Spain. Most of the German, English and French and much of the Italian is consumed locally. Russia is credited with producing an estimated 110,000 tons in 1954 but this was also used domestically. The principal countries importing to the United States are Italy, Spain, West Germany, Newfoundland and Mexico.

A review of European occurrences was given in the April issue of Mining Engineering by H. R. Hose, chief geologist of Aluminum Laboratories, Ltd. He estimates that there is a reserve of 17,000,000 metric tons of ore containing over 35 percent CaF<sub>2</sub> of which the USSR has 4,000,000, the U. K. 3,000,000, Spain 3,000,000, and Italy and West Germany 2,000,000 each, with France at 1,000,000. The principal countries of Europe are self-sufficient in fluorspar, while Italy and Spain will be the principal exporters to the U. S.

In the United States, the Victory Fluorspar Co. in the Cave-in-Rock area, east of Rosiclare, Ill., was purchased by the Minerva Oil Co., one of the principal producers of ceramic-grade spar. This property adjoins that of the Crystal, which was bought by Minerva three years ago. At Minerva's No. 1 mine a new underground crushing station was installed, the outstanding feature of which is an underground conveyor belt a half mile long. The Aluminum Company of America requested permission to prospect under the Ohio River levee south of the company's plant. Pennsylvania Salt Manufacturing Co. announced the incorporation of a whollyowned subsidiary for the development of fluorspar mining and milling operations at Salem and Mexico, Ky., to be called Calvert City Chemical Co. A new 400-ft shaft was being sunk on the Dwyer Hill fluorspar property, near Burna, Ky., by the same company.

In the West there were some new discoveries. One is in the old Bayhorse silver district, near Challis, Idaho, and near veins known for several years, belonging to A. E. Chambers. The Squaw Creek Mining Co. announced the discovery of fluorspar "along the Salmon River" which is about as indefinite a location as could be defined. Exploration for uranium in western Colorado led to the discovery of deposits on the Uncompahgre uplift in the Unaweep Mining District, Mesa County, Colo., 27 miles south of Grand Junction. The deposits are nearly vertical veins in the Wingate sandstone of Jurassic age. Thicknesses up to eight ft were reported. The claims belong to the Chesapeake and Colorado Uranium Co.

General Chemical Co. closed its fluorspar concentration plant at Deming, N. M., which has been in operation since 1933.

In Mexico, the company established by Senor Adolfo Romo, called Fluorita de Mexico S.A., doubled the size of heavy-media and flotation plant at Muzquiz, Coahuila, so that it could handle 300 tons of feed per day. Most of the ore is coming from the Encantada mesa, which involves a truck haul of about 105 miles. In October about 600 miners were in camp on that mesa. Senor Romo is also developing a new mining area southeast of San Luis Potosi, in the state of Guanajuato. The access road was expected to be finished in November, and production should start after the first of the year. Shipments will be made through Tampico.

American Smelting and Refining Company's Mexican subsidiary continued to operate its flotation plant at Agujita, Coahuila, which is alongside its coke oven plant and within a few miles of its zinc smelter at Nuevo Rosita. It acquired a number of claims on which vertical veins of fluorspar are located in the Pala district, which is roughly 100 miles southwest of the mill.

The St. Lawrence Fluorspar Co., one of the two large producers in Newfoundland, and operator of the flotation plant at Wilmington, Del., purchased a Mexican company called Cia. Minera Julieta which owned claims adjoining those of Asarco in the Paila area. The company is putting up a heavy media plant at Fraustro on the railroad 50 miles north of Saltillo. The Reynolds Metal Co. holds claims in the Paila area but on the north side of a wide valley from those held by Asarco and Minera Julieta. It was reported late in 1955 that geologists from U.S. Steel Corp. are surveying the area.

A company called Rio Grande Minerals Co. has been formed and is building a Heavy Media plant at Brownsville, Tex., to upgrade Mexican ore. From Brownsville, concentrates can be shipped by barge through the inland waterway to the Mississippi, or by boat to Gulf and East Coast ports. A flotation plant may be put up later.

The continued projected growth of both the steel and aluminum industries forecast an increased demand for fluorspar, and research in the chemical industries continues to find fluorine compounds of interest. Many of the new products have not yet come out of the laboratories, but some of the older chemicals are continuing to find wider application. A market survey showed that 91 out of every 100 families interviewed had purchased at least one of a hundred different types of push-button aerosol packages last year. In 1954 an estimated 185,000,-000 aerosol units were sold with a retail value of \$200,000,000. Every one of those units required the mining

of a few ounces of fluorspar. Champion ski experts have found that the best material on the face of their skis is Teflon, a fluorine containing plastic.

The Minnesota Mining and Manufacturing Co., which is just one of the many chemical companies experimenting with new fluorine compounds, has announced some fluorochemical collectors for ore flotation (Mining Engineering, December 1955). The January 6, 1956 issue of Colliers had an article on Fluoride toothpaste, describing interesting results with stannous fluoride at Indiana University and in the December 26, 1955, issue of Newsweek it was announced that fluoridation of water supplies has been approved by the American Dental Association, the American Medical Association and the American Public Health Association. Chicago will start water fluoridation within a month and New York City, using one billion gallons a day, will probably be the next large metropolis to adopt fluoridation. Already 22,000,000 people are drinking artificially fluoridated water. A fluorine chemical is used to make a clean cut in well casings, according to the Pennsylvania Salt Manufacturing Co.

GEM STONES—Turquoise is being mined on claims lying north and west of Columbus Flat near Candelaria, Nev., and in an open pit operation in Cochise County, Ariz. A change has been made in the mining law of Colombia affecting emerald mining. It is believed that the new law will stimulate production of the gems. The pearl harvest along Venezuela coast is estimated to have had a value of \$1,500,000 in 1955. A blue sapphire mine has been discovered in the hills of Agror, near Mansehra, Pakistan.

GILSONITE-The American Gilsonite Co., which is an affiliate of Standard Oil Co. of California and of the Barber Oil Co., will spend \$10,-000,000 in expanding its mining operation in Uintah County, Utah. duction of the asphalt mineral will be increased from 500 to 1000 tpd by using a new hydraulic method of mining. A shaft 800 ft deep will be sunk on the vein which is 20 ft wide. A jet water gun, with a nozzle velocity of 2300 psi will break the mineral down and a flume along the floor of the drift will carry the slurry to the shaft. There oversize will be crushed and all will be pumped to the surface. At the refinery, the material is converted to metallurgical coke, gasoline, gas, or used for electrodes in the aluminum industry.

GRAPHITE—The graphite chapter of the forthcoming book entitled "Mineral Facts and Problems" to be published by the U. S. Bureau of Mines, appeared in 1955. Requirements of graphite in the U. S. aver-

age about 45,000 tons, of which 80 percent is the so-called amorphous variety, largely imported from Mexico. Only 15 to 20 percent is the crystalline flake, mostly brought in from Madagascar. One critical variety of graphite is that used for making crucibles. From 3000 to 4000 tons of this grade are imported from Madagascar. Another critical variety is that from Ceylon, which is used in carbon brushes, oil-less bearings, powder metallurgy, packing and pencils. No other variety can be substituted.

A possibility that Canada may again have a graphite producer is stimulated by drilling on a property in Hastings County, Ontario, 18 miles north of Bancroft. A company called Gleneagle Graphite Mines, Ltd., has been formed to take over the property.

A report on the graphite industry in Ceylon is given in Mineral Trade Notes for May, as is also a table showing world production from 1945 to 1954. Mexico is the leading producer, although, before the Korean war Korea led, and it still exceeds Madagascar, although Austria and West Germany take second and fifth places respectively. Madagascar is in fourth place.

A flotation method to recover fine graphite has been installed by the Kaiserberg Graphite Co. of Styria, Austria. West Australia is expected to be a producing area, with the development of a deposit at Munglinup.

GYPSUM—Since gypsum is used widely in the building industry, a boom year in construction means a boom year for gypsum.

National Gypsum Co. of Buffalo celebrated its 30th year with the announcement that it has 39 plants and that its earnings for the first six months of 1955 were the highest on record. It plans to spend \$95,000,000 in expansion during the next five years. New plants will include gypsum plants in Toronto and Montreal. two in California; a hard board plant at Mobile, Ala., an asbestos mine and plant in Quebec and an increase in industrial lime at Gibsonburg, Ohio, and Medicine Lodge, Kans. Another new plant just announced is to be at Burlington, N. J. The gypsum mine and mill near Halifax and Milford, Nova Scotia, was formally opened July 16. The quarry taps the largest gypsum deposit in North America, with proven reserves exceeding 200,000,000 tons. Descriptions of the mine and loading facilities are given in Rock Products for September and Engineering and Mining Journal for November.

A description of U. S. Gypsum Company's operations was given in Fortune for September, under the provocative title "No Nonsense." When the 1953-54 recession fizzled out, and it became apparent that gypsum products would continue in short supply, U. S. Gypsum appropriated \$40,000,

000 to get a new plant into operation by the end of 1955. U.S. Gypsum has gypsum sources in eleven states, Nova Scotia and Jamaica, as well as deposits of perlite, lime, etc. It owns and operates three 10,000-ton vessels. and makes almost all of the paper it uses for its gypsum board in six plants and is building a seventh at Houston. It has a paper bag plant at Oakmont, Pa. With 29 integrated gypsum plants in 17 states and three Canadian provinces, it has about 50 percent of the U.S. business in gypsum products. A recent announcement is an increase in its facilities at Plaster City, Calif., to produce enough lath and board for 45,000 new homes annually.

Another aggressive gypsum company is Kaiser Gypsum Co. of Oakland, Calif. It is expanding its Long Beach plant by 60 percent and has purchased 38 acres at Antioch, Calif., on which it will build a plant to make 94,000,000 sq ft of board in 1956 and add 180,000,000 sq ft additional capacity later.

Another California company, Pabco Products, has bought a deposit near Lovelock, Nev., and will build a gypsum plant there.

The Ruberoid Co. of New York has acquired gypsum deposits in Martin County, Ind., and will build a plant there. Both U. S. Gypsum and National Gypsum are also developing in Indiana. Union Gypsum is building a plant at Phoenix, Ariz.

In Canada, British Plaster Board, Ltd., has purchased all of the stock of Western Gypsum, Ltd., which operates plants at Winnipeg and Calgary. A new company, Columbia Gypsum Co., Ltd., will take over property at Windermere, B. C. Bellrock Gypsum Industries, Ltd., has taken an option on plant and quarry of the Atlantic Gypsum Co. of Corner Brook, Newfoundland.

The 1955 production of gypsum wall board exceeded the astronomical figure of seven billion sq ft.

A new anhydrite mine was opened at Sandwith, on the west coast of Cumberland, England. An estimated 7000 tons of anhydrite will be mined daily, to be converted to sulphuric acid and cement.

KYANITE — Another producer in the Kings Mountain area, N. C., will be Carolina Mines, Inc. A deposit of dumortierite was discovered by the U. S. Geological Survey seven miles north of Basin, Jefferson County, Mont.

In Canada, the Hoyle Mining Co. was continuing exploration of its property in Dryden township, 12 miles east of Sudbury. Another deposit is on the Big Bend Highway in British Columbia, 45 miles north of Revelstoke.

LIGHT WEIGHT AGGREGATES-

Under this heading products made from expanded clays and shales are considered, but perlite is excluded since it is discussed under its own heading. In general, expanded clays and shales are produced in the East and Middle West, whereas perlite is distinctly a Western product. Expanded shale is produced in kilns at temperatures of 1900° to 2200° F. Gases formed within the shale expand. forming tiny air cells which are retained upon cooling and solidification. Since the process was first perfected in 1917 by Stephen J. Hayde, many of the products are called Haydite. An excellent review of the material is given in Rock Products for January. Instead of a kiln, a Dwight-Lloyd sintering machine is used by the Onondaga Brick Co. at Warners, N. Y., and by the Roanoke-Webster Brick Co. at Webster and Roanoke, Va.

In Canada, five new plants using kilns are just new or still under construction. Two are in Regina, two in Winnipeg and one in the Vancouver area. There is only one shale plant in eastern Canada, at Cooksville, Ont., although two plants, in Hamilton, Ont., and Sydney, Nova Scotia, are using foamed slag as light weight aggregate.

An entirely different product is of Swedish origin and is called Siporex. This is made from a blend of portland cement and fine sand, to which aluminum powder and certain additives are mixed. The slurry is very wet when put into molds. After six to nine hours a cellular concrete has formed. The block is cut to exact dimensions and the units are then put in an autoclave under steam pressure of 10 atmospheres for one hour. The units are ready for shipment after 30 hours of aging. Siporex can be made in densities of 25 to 50 lb per cu ft. A plant has just been built in Mexico, one in Montreal, and another in Caracas.

LIME—The Lime Association reports that there are now 65 companies with 108 plants producing lime for the open market. The association has published a map showing the location of the plants.

LIMESTONE—Like the big new dolomite plant in northern Michigan described above, another big high-calcium limestone deposit was put into full operation near Alpena, Mich., by the Kelly Island Co., of Cleveland. This company operates three steamers and shipped 4,500,000 tons of stone in 1955.

In Ohio, the Columbia Cement Division of the Pittsburgh Plate Glass Co. has converted its quarry to an underground operation. Annual production is 600,000 tons. The Kaiser Steel Co. has purchased a large highgrade limestone deposit at Cushenbury, Calif. The Santa Fe R.R. will build a railroad to the property.

American Marietta Co. of Chicago has acquired the Standard Lime and Stone Co. of Baltimore, which has nine plants in seven states producing portland cement, crushed limestone and sintered dolomite. The company has limestone deposits in Maryland, Virginia, West Virginia, Pennsylvania, Ohio, Indiana and Illinois.

The Somerset Limestone Co., Inc. of Somerset, Pa., has announced a method of removing "flats" by a so-called "de-flatter" screen. Steel bars welded to the screen wire cause the flat pieces to tilt up as they travel down the incline slope of the screen. Then they fall end over end and drop down through the screen openings. Flat pieces in the final products have been reduced from 60 percent to 5 percent for the same mesh sizes.

LITHIUM—The mystery minerals of 1955 were certainly spodumene and the other "ores" of lithium, ambly-

nium and it may be 20 years before the development of the fusion reactor. Yet, that uncertainty has not deterred a large number of people from investing their own (and other people's) money in deep holes in the ground.

There used to be four companies concerned with lithium - Maywood Chemical Co., Lithium Corp. of America, American Potash and Chemical Corp. and the Foote Mineral Co. Now there must be at least a dozen. Foote continues to be the largest producer, with a mine at Kings Mountain, N. C., and a mill and chemical plant at Sunbright, Va., to which ore imported from Africa is also shipped. American Potash and Chemical Corp. was producing such lithium as could be recovered as a byproduct from its Searles Lake, Calif., potash brines, in which lithium chloride occurs to the extent of 0.032 percent. Probably in recent years the company has produced 1,500,000 to 2,000,000 lb of lith-

The Lithium Corp. of Minneapolis has put \$7,000,000 into an operation at Bessemer City, N. C., and is mining spodumene from pegmatites at Kings Mountain, N. C. It also has mining operations in South Dakota but recently announced that they would be put on a stand-by basis. It has a chemical plant in St. Louis Park, Minn., in which lithium metal, hydroxide, and other lithium chemicals are made. Lithium Corp. has purchased 200,000 tons of spodumene concentrate to be produced in five years by Quebec Lithium from its mine at LaCorne township, Que., 25 miles north of Val d'Or.

It is in Canada that most of the activity has occurred. Quebec Lithium, a company owned jointly by the Sullivan Consolidated, East Sullivan and Quebec Copper Mines has done 54,000 ft of drilling, and is said to have reserves of 10,000,000 tons of ore running 1.3 percent Li2O. A shaft, 525 ft deep, was finished in June 1955 and its mill was in operation by November. Adjoining ground is owned by Canadian Lithium Mining Corp., Ltd. That company has been busy drilling its property and in September was reported to have sold an additional \$300,000 worth of stock. Also in the same area are International Lithium Mining Corp., Mass-beryl Lithium Co., Ltd., and Ascot

Metals Corp.

In Ontario, lithium has been discovered in the Beardmore area a few miles west of the Little Long Lac gold camp. This is called the McKirdy region, and is believed by some to be the best in Canada. A company called Conwest has 80 claims. A new discovery 10 miles east of McKirdy has been reported.

In Manitoba, 100 miles northeast of Winnipeg, is the Cat Lake area. There the Violamac Mines, Ltd., controlled by Viola R. MacMillan, has a group of 20 claims adjoining property of the Maskwa Nickel-Chrome Mines, a Falconbridge property. Drilling is claimed to have found 2400 tons per vertical foot to a depth of 700 ft, averaging 1.3 percent Li<sub>2</sub>O. Seven miles east a company called Lithium Corporation of Canada has done 6000 ft of drilling, and was planning a 500-ft shaft on the Irgon claim. The property has reportedly been sold to Toronto interests.

On Great Slave Lake, in the Northwest Territories pegmatite dikes containing lithium have been found 30 miles east of Yellowknife. Alberta Central Explorations and Regent Uranium Lithium Explorations have started prospecting.

In the United States, Midwest Lithium Corp. has announced that a lithium plant will be built in the Black Hills, and the United States Lithium Corp. has claims in Gunnison County, Colo. Methods of mining and concentrating spodumene were described



Many small rock and gravel operations make up over 75 percent of the gross volume of all industrial minerals

gonite, lepidolite and petalite. Millions of dollars were being poured into lithium properties and lithium developments, but if anyone had any assurance that a sufficient demand will develop to absorb the output of all of these properties, and at a price that will pay a return to the stockholders, he certainly had a private wire to some oracle that was not in most phone directories. Feeling concern over this subject, the editors of Engineering and Mining Journal dug into the matter. They imply that lithium is used in the H bomb. They wrote: "When a lithium atom is bombarded with a neutron, it forms helium and tritium which reacts with deuterium to produce more helium and release great amounts of energy, in either radiation or kinetic form. This is the fusion reaction." Many difficulties seem to be in the way before lithium will become a friendly rival to uraium carbonate annually. Now the company has joined with Bikita Minerals, Ltd. of Southern Rhodesia which has lepidolite available, in a \$6,600,000 operation. Bikita is owned by Selection Trust of South Africa and the American Metal Co. A plant will be located in San Antonio where chemical grade limestone and natural gas are available. A new company has been formed called American Lithium Chemical, Inc., in which American Potash holds 50.1 percent interest. An initial shipment of 11,-000 tons has been made from the Rhodesian mine.

Maywood Chemical Co. has not undertaken large expansion projects. It receives spodumene from the famous old Etta mine in the Black Hills and shares in the output of the Tin Mountain mine of the International Minerals and Chemical Corp. It also imports ores from Brazil.

in the November issue of Mining Engineering and the Chemistry of extraction of lithium from its ores was described in the same issue.

Deposits in northeast Brazil were described by Mather in the September 1954 issue of Mining Engineering. In Western Australia a small scale production of spodumene was reported at Ravensthorpe. Exports of lithium minerals from Southwest Africa are given in Mineral Trade Notes for July 1955.

MAGNESITE—The year 1954 was a poor one for the magnesite industry, which is tied so closely to the steel industry. In 1955, however, the Northwest Magnesite Co. at Chewelah, Wash., reported a greatly increased demand.

Standard Lime and Cement Co., a subsidiary of American Marietta Co. of Chicago, has purchased the brine wells of the Michigan Chemical Corp. at Manistee, Mich. The company expects to produce magnesium chloride.

MICA—With the outlook for vast expansion of the electronics industry, mica and other dielectrics will be required in ever increasing quantities.

The Domestic Mica Minerals Association was formed at Spruce Pine by operators of some 80 mica mines delivering ore to the U.S. mica purchasing depot at Spruce Pine, N. C. Considerable confusion occurred in that area when the General Services Administration suddenly returned to a former policy of paying only \$600 a ton for hand cobbed mica. On the basis of a more liberal price, many old mines had been reopened and new mines were started. Going back to the old price left marginal producers in financial difficulty. Also, they had to go back to the "A" program in which the miner prepares his own mica. Under the "B" program the government did all of the processing and had hired most of the skilled labor. Meanwhile, shipments of dry ground mica from the area have been running at an all time high. A rich strike was made in Macon County, N.C.

A summary of statistics on mica production and exports from India for the last half of 1954 is given in Mineral Trade Notes for July. One fact brought out was that Communist countries will pay more for poorer quality material than will the free world. Hence, in spite of the deferred payment system, the average Indian exporter prefers the Communist market. The India mica industry is concentrated in the state of Bihar and in Approximately 75 percent Andhra. of the mica in the Bihar belt is obtained from underground mines up to 500 ft in depth.

The Indian mica industry has suffered a loss of some of its overseas business, due, perhaps, to a release by the United States of stockpile material, growing competition from Brazil, high ocean freights, and increasing use of "micanite," which is sheet built up from scrap.

Recovery of mica from the silt accumulated behind the Nolichucky dam in Tennessee has been started at Greenville by the International Minerals and Chemical Corp. The equipment will cost about \$400,000 and is expected to be in production early in 1956 at a rate of 100 tpd. The material will be used in roofing, paint and rubber.

A development in the southern tip of the Alaskan panhandle by B. C. Mica Mines, Ltd. to produce muscovite mica made good progress during the year.

Synthetic mica production at the rate of 1000 tons annually was started

and uranium in its proposed atomic power plant. However, at the end of June the Government purchase contracts with three monazite producers in the Boise basin area of Idaho expired and were not renewed. Those operations then shut down.

Lindsay Light & Chemical Co. is the largest user of these ores. Their director of research wrote in April in the Mines Magazine of the Colorado School of Mines that South African monazite has become a serious competitor of domestic ores. Later in the year it was announced that Lindsay has optioned claims in northwestern Saskatchewan on which a vein 12 ft wide has been found yielding a crude ore analyzing one percent thorium.

Exploration of monazite placers near Sheridan, Wyo., and Hamilton, Mont., were under way during the



Underground limestone mining

early in the year by the Mycalex Corp. of America. The ingredients are aluminum oxide, magnesium oxide, silica, fluorspar and potash feldspar. So far the crystal sizes are small.

The Mica Insulator Co. of Schenectady makes laminated plastic from fine mica and micanite in continuous sheets. Integrated Mica Corp. of Woodmere, N. Y., makes mica sheets of paper thickness at a price that permits its substitution for asbestos paper used in electrical insulation.

MONAZITE — Monazite and thorium were much in the news during the year. Everyone was talking about it, but nobody seemed to really want any. Sheldon Wimpfen, of the Grand Junction station of the AEC, told audiences both at the Idaho Mining Association at Sun Valley and the American Mining Congress at Las Vegas, that the AEC has no interest in thorium. Earlier in the year Consolidated Edison Co. of New York announced that it will use both thorium

Both are probably extensive. In the Wet Mountains of Custer and Fremont Counties, Colo., veins occur with thorite. The Wet Mountain Mining Co. announced that 15 tons of high-grade thorium ores had been put into stockpiles and a contract was being negotiated with Lindsay Light & Chemical Co. Sands were reported in the Sangre de Cristo Mountains at Lost Creek, 60 miles southwest of Las Vegas, N. M. Some veins, or zones of alteration in a phonolite in the Bear Lodge Mountains north of Sundance, Wyo., are "hot" to a scintillator, and analyze for thorium, but the average may be only 0.25 percent. A company called American Mineral Development Corp. talked glibly of constructing a thorium refining plant in the West.

The South African deposit from which shipments have been made to this country is at Van Rhynsdorp. Thorium content is said to be from one to two percent. The government of Ceylon is reported to have plans

for a pilot plant to work thorianite deposits found in that country. Deposits of monazite are reported in British Guiana in the Rupununi district adjoining the Brazilian border.

Battelle Institute of Columbus, Ohio, has announced that a process for recovery of thorium and the rare earth metals from monazite sand has been developed in a research project sponsored by the Atomic Energy Commission.

It was announced that the production of bastnaesite ore at Mountain Pass, Calif., by the Molybdenum Corp. is running about 3000 tons of 10 percent ore per month.

NITRATES—According to Mineral Trade Notes for June, the production of nitrate for the first quarter of 1955 was 309,484 metric tons of which two-thirds was supplied by the Guggenheim method and one-third by old Shanks process plants. The United States received 42.8 percent of the exports during that quarter. The production in 1954 was 1,570,000 tons. An analysis of the world situation in nitrogen is also given in the June number of Mineral Trade Notes.

PERLITE-Perlite is a variety of volcanic glass with dissolved water. When heated, the water turns to steam and converts the originally dense rock to an artificial pumice. A good quality perlite will expand from 400 to 2000 percent. Being of recent volcanic origin, no deposits of usable perlite are found east of the Rocky Mountains since such rocks that may have existed there in earlier geologic periods have long since been altered to some other kind of rock. Reserves in the Western states, however, are huge. Although still small, the industry has grown 46 times since it started in 1946. The value of expanded perlite sold in 1953 (the last year for which we have final figures) was \$8,894,735. About 80 percent of the expanded perlite is used in premixed gypsum plaster, and another 10 percent in concrete for roof decks, pre-fabricated panels and for floors. In Pittsburgh, Pa., four large office buildings were built with exterior wall slabs of sheet aluminum or steel, backed up with perlite concrete, according to an article in Mining Engineering for February.

News items tell of the purchase by International Minerals and Chemical Corp. of a perlite property in Inyo County, Calif., a drying and grinding plant near Big Pine, and an expanding plant at Los Angeles. The same company has developed a filter aid made from perlite.

Great Lakes Carbon announces that new franchise agreements to produce expanded perlite under the "Permalite" trade name have been completed with four more processors, bringing the total number to 23. The company has leased the mine and plant of the California Perlite Corp. at Klondike, Calif. The company also operates mines at Socorro, N. M., and Rosita, Colo.

The Ruberoid Co. has announced the addition of Lite-Wall gypsum plaster made from perlite to its line of gypsum products.

Processing of perlite was described by Robert H. Weber in *Mining Engi*neering for February and by H. A. Stein and J. B. Murdock, in the *Cali*fornia Journal of Mines and Geology for April.

The Perlite Institute reports that an unprotected 24 gauge corrugated steel roof, insulated with perlite concrete 2% in. thick withstood 60 minutes of continuous fire exposure at temperatures reaching 1700° F.

REFRACTORIES-Statistics on the export of sillimanite from India



Vermiculite operation in Transvaal.
Union of South Africa

for the year 1953 are given as 3232 tons in *Mineral Trade Notes*. This indicates that Indian sillimanite is no longer an important refractory material in the United States.

Harbison-Walker completed a silica refractories plant at Leslie, Md., during the year. It has a similar plant at Windham, Ohio. Kaiser Aluminum and Chemical Corp. which makes magnesia refractories at its plant at Moss Landing, Calif., is building another basic refractories plant at Columbiana, Ohio, at an estimated cost of \$4,000,000. Food Machinery and Chemical Co. in describing its Wisconsin process for nitrogen fixation, which is conducted at 4400° F, states that the refractory used is MgO. Even Cerro de Pasco has gone into the refractories business by purchasing a 40 percent interest in Refractarios Peruanos, S. A., which will operate a plant at Lima for production of fireclay, silica and basic refractories.

ROOFING GRANULES—This industry, also tied directly to construction, set another record for the year, which probably be close to 2,000,000 tons. Over 85 percent of American homes now have a granule coated asphalt roof. In Canada, Building Products, Ltd., completed a new plant for crushing and coloring granules at Havelock, Ont.

SALT—In Canada, the Canadian Rock Salt Co. is sinking a shaft 16 ft in diameter at Windsor, Ont. The Malagash Salt Co. is developing an underground mine at Fugwash, Nova Scotia.

Salt domes in the Arctic were described by Heywood in the February Bulletin of Canadian Institute of Mining and Metallurgy.

GLASS SANDS AND SILICA PRODUCTS-International Minerals and Chemical Corp. is producing at Kona, N. C., a silica product from its feldspar operations which analyzes 0.005 percent Fe<sub>2</sub>O<sub>3</sub>. It is believed this is the lowest iron content of any silica produced commercially in the United States. In the West there were several developments. Owens-Illinois Glass Co. put a new glass sand plant into operation at Ione, Calif. Pacific Clay Products Co. announced plans for a new plant at Camanche, Calif., to produce 125,000 tons of glass sand annually. The J. R. Simplot Co. purchased a silica mining and processing plant at Overton, Nev., with a capacity of 100,000 tons per month. The Brentwood Silica Sand Co. has opened a glass sand quarry at Brentwood, Calif.

Canada has no production of high grade silica sand, but since the use of sand for hydraulic fracturing of oil formations proved to be especially successful in the Pembina field of central Alberta, there is justification for starting a plant. The Peace River Glass Co. Ltd., of Edmonton plans to develop a deposit in its area; the Dominion Silica Corp. is grinding high quality quartzite at St. Donat, Que. The Canadian Silica Corp., Ltd. has a property at St. Canut, Que.

A process of making glass sand by using scrubbers and cyclones at the plant of the Crystal Silica Co., Oceanside, Calif., was described in Rock Products for September, and the preparation of silica sand for the hydrafrac process at Ottawa, Minn., was described in the same journal for December.

Flotation of quartz with both cationic and anionic collectors was described in three papers during the year in *Mining Engineering*. Two by A. M. Gaudin and D. W. Fuerstenau were published in January and Octo-



Vermiculite samples

ber, and one of P. L. de Bruyn appeared in the March issue.

The important field of silicones, which are of course made from silica and which are finding such wide applications, was covered in a book by Rob Roy McGregor, "Silicones and their Uses," published by McGraw-Hill. The use of a silicone and mica insulation in electric motors for mine use was described in the Engineering and Mining Journal for December. The General Electric Co., which developed these motors, is also offering a water repellent silicone for coating concrete pavements. The silicones act to seal the pavement and samples exposed to "freeze-thaw" tests lasted twice as long as untreated samples.

SLAG—Waylite Co. of Chicago has purchased the Duluth Slag Co. and has begun the construction of a new expanded slag plant at the Interlake Iron Corp. property. This plant will use a Brosius machine for expanding the slag.

The use of water granulated slag as a fertilizer was discussed in *Rock Products* for May.

SODIUM CARBONATE (TRONA)—Intermountain Chemical Co. at Green River, Wyo., a subsidiary of Ford Machinery and Chemical Corp., let a contract with the Dravo Corp. for sinking its third shaft. This is 18 ft in diameter and is to be 1600 ft deep when complete in October 1976. It is to be used for ventilation.

SODIUM SULPHATE—The shortage of salt cake which developed in late 1954 was eased in 1955 by increased imports and by a new plant which started in July by the West End Chemical Co. at Searles Lake, Calif. This plant has a capacity of 50,000

tons annually. Ozark-Mahoning Co. which operates a natural salt cake plant at Monahans, Tex., expects to add 50,000 tons to its annual capacity in 1956. All of this reflects the growing importance of the paper business.

STONE—A deposit of Verde Antique marble has been discovered near

Valdez, Alaska. It is a rare type of light jade green marble, and is found in only a few other places in the world.

TALC—Statistics for the production of talc in the world are given in *Mineral Trade Notes* for August. In 1954 the United States produced 592,086 short tons, followed by Japan with 461,087, France with 130,844 and Italy with 95,302.

The trend continues for finer and finer "micronized" tales. The plant and operating methods of the Eastern Magnesia Tale Co. at Johnson, Vt., was described in the Denver Equipment Co. Bulletin M4-B66. In the East, demand for ground tale and soapstone showed an increase over 1954.

VERMICULITE—Like in all other industries, there is now a Vermiculite Institute, which held its meeting in April. One paper described a pump to pour 1800 sq ft per hour of vermiculite concrete, used for roof decks. Vermiculite was used as fire walls in the new First Security Building in Salt Lake City. Machine applied vermiculite concrete spandrel walls were given a five-hour fire rating. Other papers dealt with the use of vermiculite as a carrier for insecticides and herbicides

#### **Mechanical Mining**

(Continued from page 73)

auger drilling to control mountain bumps.

Gradual increase in use of a-c power underground continued in 1955.

Advances in mechanical mining were paralleled by discovery of hazards not previously considered of great importance. Fire hazards in connection with operation of belt conveyors and frictional ignition of gases by mining machines and the increased rate of emission of gases from the far greater amount of face exposed per shift are cases in point. Security measures have in such cases been promptly devised and widely adopted.

One of the most important and encouraging developments in connection with mechanical mining has been the recognition of importance of skillfully assembled and expertly analyzed time study data. Some management people, unfortunately, learned by experience that a poor time study job is worse than none and that a mass of detailed data is useless for control purposes unless it is intelligently analyzed and applied.

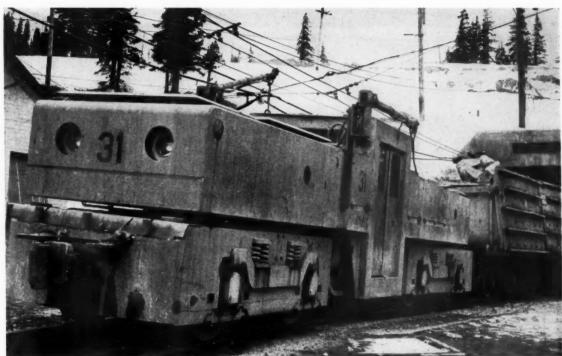
#### General

Optimistic views are widely expressed concerning the future for bituminous production. Typical of these

expressions are those attributed to the president of one of the principal suppliers of equipment to the industry. This outstanding personality is quoted as expressing confidence that "coal mining appears to have started a new and continuing cycle of growth." Also, that "over-all we regard the coal mining industry as one of the dynamic growth industries in America." Further, that the industry has "some of the most imaginative, aggressive, and technologically expert managements to be found in American industry."

With these statements the writer is in full accord. Markets, managements, and mechanization, supply the potential for sound optimism.





Haulage locomotive at the mine of one of the foremost molybdenum producers

# Molybdenum

### Moly Hits Peacetime Peak—Future Growth Expected

PRELIMINARY statistics indicate that Free World production and consumption of molybdenum again rose in 1955, reaching new peacetime highs.

#### **New and Expanding Markets**

Greater use of the material in the alloying of iron and steel in America and Western Europe, coupled with growing applications in chemical and other non-metallurgical fields raised estimated consumption by more than 14 million pounds over the previous year. Estimated production topped output in 1954 by about 2.5 million pounds. Smaller amounts of molybdenum were stockpiled during the year, providing the cushion which permitted consumption to increase faster than demand without causing serious shortages.

Industrial importance of molybdenum is growing, indicating increasing consumption of the material over the years. It is anticipated that most established applications will be maintained, newer present uses will become more generally adopted and completely new applications for the versatile material will be developed.

The iron and steel industries of the Free World remain the largest consumers of molybdenum. Furthermore, with steel capacity on the rise and with more stringent demands being placed upon alloy and high-alloy steels by structural and design engineers, "moly" will become increasingly important as an alloying element. In 1955 molybdenum was used increasingly in high-strength iron and steel castings, tool steels, stainless steel, heat resistant steels and high temperature alloys. During the year considerable testing and developmental work was accomplished in other materials such as carburizing steels, metallic molybdenum and molybdenum base allovs.

Engineers and chemists during 1955 became increasingly interested in using molybdenum for an expanding list of non-metallurgical applications, none of which required great tonnages during the year but any one of which could become an important consumer in the future. For example, lubrication engineers have known for several years that molybdenum sulfide can form a low-friction protective coating on metallic parts that will remain

effective after normal lubricants have worn out or have been wiped away. Already included in many industrial greases and oils, tests are now under way using the material as an additive to chassis greases for automobiles, and use in journal boxes of railway cars is now developing into a promising new application.

#### Trace Element and Chemical Uses

Farm scientists in Australia discovered several years ago that molybdenum is an essential trace element in crop soils. They found that additions of small amounts to molybdenum-deficient areas brought about sensational increases in crop yields. Experiments in America and many other parts of the world have uncovered large molybdenum-deficient areas and field tests have brought about striking improvements in such crops as alfalfa, citrus fruits, and cauliflower. Although still confined in most part to the agricultural experiment station, farm scientists are confident that molybdenum will soon add to the productivity of crop lands throughout the world.

Uses of molybdenum in the chemical industry are becoming increasingly important. Contamination resistant molybdenum catalysts have already gained a good foothold in the petroleum industry and hydroforming and de-sulfurization chemists are experi-

(Continued on page 146)



Capacity of mechanical loading equipment shipped in 1955 was 22 percent greater than in the previous year

# Sales of Coal-Mine Equipment

Increased Coal Production Was Reflected by a Marked Rise in Equipment Sales

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SHIPMENTS of mechanical loading equipment for underground use in coal mines in the United States, in terms of capacity, were 22 percent more in 1955 than in 1954. The capacity of mechanical cleaning equipment sold for use at bituminous-coal mines was 95 percent more in 1955 than in 1954. Shipments of coal recovery augers, shuttle cars, and "mother" conveyors for use in coal mines in the United States increased in 1955 from 1954, while face-conveyor shipments decreased during the same period.

This survey was made possible by the courteous cooperation of all known manufacturers of mechanical cleaning equipment for bituminous coal mines and manufacturers of mechanical loading and supplementary haulage equipment and coal recovery augers for use in all coal mines in the United States. Data from various trade journals were also utilized.

Mechanical loading units, coal recovery augers, and supplementary haulage equipment "Sales in 1955" represent shipments made during the year. Of the total capacity of mechanical cleaning equipment sold in 1955, 35 percent was placed in operation during that year; the remainder (65 percent) will be installed later.

#### Mechanical Loading and Mining

Bituminous coal and lignite mechanically loaded in underground mines increased from 244,000,000 tons in 1954 to 300,000,000 tons in 1955 or 23 percent. Production at strip mines

increased 93,000,000 to 108,000,000 tons, or 16 percent and auger mine production increased from 3,000,000 to 6,000,000 tons during the same period.

Table I shows data on bituminous coal and lignite production, by methods of mining, and mechanical cleaning for 1953-55, inclusive. The percentage of total output mechanically loaded and mechanically cleaned con-

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tinues to increase. During 1955, approximately 89 percent of the total output was mechanically loaded at underground mines, loaded by power shovels at strip mines, or mined by augers along highwalls in strip mines.

Underground production of bituminous coal and lignite, by methods of loading, is shown in table II. The preliminary figures for 1955 show that 85 percent of the underground output was loaded mechanically, and the remainder (15 percent) was handloaded into mine cars.

Auger Mining. The use of augers for coal recovery along highwalls in strip mines began about 1945, but separate data on number of augers in use and tons produced by auger mining was first collected for 1952.



Production from coal augering operations averaged 25 tons per man day in

Auger mining at soft coal mines in the United States averaged 25 tons per man per day in 1953, compared with 18 at strip mines and seven at underground mines. Table 24 in the U.S. Bureau of Mines Mineral Market Summary 2339 shows a comparison of auger mining with other types of mining. A few coal recovery augers were used in underground bituminous coal mines, and the production from these mines was included with underground mechanically loaded coal. The first coal recovery auger for use at Pennsylvania anthracite mines was shipped in 1955.

Reports received from four manufacturers of coal recovery augers show that 66 augers were shipped in 1955 and all except one was for use along highwalls at strip mines. Table 3 shows coal recovery auger shipments in 1953, 1954 and 1955, and table V the number in use in 1953 and shipments in 1954-55 by States.

Types of units sold. Table III lists the units of mechanical loading and mining equipment shipped for use at

TABLE I—BITUMINOUS COAL AND LIGNITE PRODUCTION, BY METHODS OF MINING AND MECHANICAL CLEANING, IN THE UNITED STATES, 1953-55, INCLUSIVE

|  | 1953                     |               | 1954                     | 1             | 1955                     |               |  |
|--|--------------------------|---------------|--------------------------|---------------|--------------------------|---------------|--|
|  | Thousands<br>of net tons | % of<br>total | Thousands<br>of net tons | % of<br>total | Thousands<br>of net tons | % of<br>total |  |
| Hand-loaded underground<br>Mechanically loaded under |                          | 15.6          | 52,000                   | 13.3          | 51,000                   | 11.0          |  |
| ground   | 278,329                  | 60.8          | 244,000                  | 62.2          | 300,000                  | 64.5          |  |
| Mined at auger mines                                 |                          | 0.5           | 3.000                    | 0.8           | 6,000                    | 1.3           |  |
| Mined by stripping                                   | 105,448                  | 23.1          | 93,000                   | 23.7          | 108,000                  | 23.2          |  |
| Total production                                     | 457,290                  | 100.0         | 392,000                  | 100.0         | 465,000                  | 100.0         |  |
| Mechanically cleaned                                 | 241.759                  | 52.9          | 224,000                  | 57.1          | 279,000                  | 60.0          |  |

TABLE II—UNDERGROUND BITUMINOUS COAL AND LIGNITE PRODUC TION, BY METHODS OF LOADING, 1953-55, INCLUSIVE

|   | 1958                               |                   | 1954                      | 1             | 19551       |               |  |
|---|------------------------------------|-------------------|---------------------------|---------------|-------------|---------------|--|
|   | net tons                           | % of<br>total     | net tons                  | % of<br>total | net tons    | % of<br>total |  |
| Mobile loading machine<br>Loading direct into                             | es:                                |                   |                           |               |             |               |  |
| mine cars.<br>Loading onto con-   | 65,910,130                         | 18.9              | (2)                       | (2)           | (2)         | (2)           |  |
| veyors<br>Loading into shuttle  | 10,532,695                         | 3.0               | (2)                       | (2)           | (2)         | (2)           |  |
| cars  | 1,56,142,324                       | 44.6              | (2)                       | (=)           | (2)         | (2)           |  |
| machines Scrapers Conveyors equipped with duckbills or other self-loading | 11.830,097<br>238,839              | 3.4<br>0.1        | (2)                       | (2)<br>(2)    | (2)<br>(2)  | (2)<br>(2)    |  |
| heads<br>Hand-loaded conveyors  | $\substack{8,530,949\\25.143,948}$ | $\frac{2.4}{7.2}$ | (2)<br>(2)                | (2)<br>(2)    | (2)<br>(2)  | (2)<br>(2)    |  |
| Total mechani-<br>cally loaded:<br>Hand-loaded into mine<br>cars          | 278,328,982<br>71,221,990          | 79.6<br>20.4      | 244,000,000<br>52,000,000 | 82.4<br>17.6  | 300,000,000 | 85.5          |  |
| Total under-<br>ground pro-<br>duction                                    | 349,550,972                        | 100.0             | 296,000,000               | 100.0         | 351,000,000 | 100.0         |  |

TABLE HI—UNITS OF MECHANICAL LOADING AND MINING EQUIPMENT SOLD FOR USE IN COAL MINES, AS REPORTED BY MANUFACTURERS, 1950-55, INCLUSIVE

| Type of equipment                            | 1950           | 1951     | 1952 | 1953 | 1954 | 1955 fr     | Change<br>rom 1954<br>percent) |
|--|----------------|----------|------|------|------|-------------|--------------------------------|
| Bituminous-coal and lignite<br>mines:        |                |          |      | 100  | 0.0  | 100         | . 90 4                         |
| Mobile loading machines ]                    | 289            | 287      | 206  | 180  | 92   | 120         | +30.4                          |
| Continuous mining machines                   | 3              | 3        | -    | 67   | 101  | 109         | +7.9                           |
| Coal recovery augers                         | (1)            | (1)      | (1)  | 57   | 55   | 65          | +18.2                          |
| Scrapers <sup>2</sup>                        | 40.            | <b>4</b> | 8    | 11   | 0.40 | 0.40        | 100                            |
| Shuttle cars                                 | 465            | 524      | 428  | 437  | 242  | 348         | +43.8                          |
| Conveyors: <sup>8</sup> "Mother"             | 132            | 114      | 67   | 58   | 19   | 78          | +310.5                         |
| Room or transfer                             | 316            | 297      | 155  | 87   | 61   | 143         | +134.4                         |
|  | 116            | 111      | 76   | 49   | 115  | 76          | -33.9                          |
| Face <sup>4</sup> Anthracite mines (Pennsyl- | 110            | 111      | 10   | 40   | 110  | 10          | -30.0                          |
| vania):                                      |                |          |      |      |      |             |                                |
| Mobile loading machines .                    |                |          |      | 1    | 17   | 1           | -94.1                          |
| Continuous mining ma-                        |                | 0 4 8    |      | 1    | 7.1  |             | -01.1                          |
| chines                                       |                |          |      |      | 1    |             |                                |
| Coal recovery augers                         | (1)            | (1)      | (1)  |      |      | 1           |                                |
| Scrapers <sup>2</sup>                        | 8              | 8        | 5    | 3    |      | 1<br>2<br>8 | *****                          |
| Shuttle cars                                 |                |          |      |      | 14   | 2           | -42.9                          |
| Conveyors; <sup>3</sup>                      |                |          |      |      | 1.4  | 0           | Im. O                          |
| "Mother"                                     | 1              |          |      |      |      | 3           |                                |
| Room or transfer                             | $\frac{1}{57}$ | 34       | 34   | 16   | 24   | 7           | -70.8                          |
| Face4  |                | 8        | 13   | 2    | 11   |             | 10.0                           |
| Number of manufacturers                      |                | 0        | 10   | -    | 11.  |             |                                |
| reporting                                    | 20             | 21       | 99   | 25   | 23   | 99          |                                |

<sup>1</sup> Not available. Total number of coal recovery augers sold 1946-52, inclusive, was 271.

<sup>2</sup> Reported as scrapers or scraper haulers and hoists.

<sup>3</sup> Conveyors are classified as to the length the power unit has capacity to take: "Mother," capacity over 500 ft; room or transfer, capacity 100 ft to 500 ft; face, capacity under 100 ft.

<sup>4</sup> Includes "bridge" conveyors.

### TABLE IV—SALES OF MECHANICAL LOADING EQUIPMENT IN 1954 AND 1955 COMPARED WITH MACHINES IN USE IN PRECEDING YEARS

|  | Number | of machin  | es in use, | as reported | by mine op          | erators             | mac<br>sol<br>repe<br>by n | ber of<br>hines<br>d as<br>orted<br>nanu-<br>urers |
|--|--------|------------|------------|-------------|---------------------|---------------------|----------------------------|--|
|  | 1948   | 1949       | 1950       | 1951        | 1952                | 1953                |                            | 1955   |
| Bituminous coal and lignite mines:                   |        | 20.20      |            |             |                     | 2000                | 2002                       | 2000   |
| Mobile loading machines. Continuous mining machines. | 3.980  | $\}$ 4.205 | } 4.318    | } 4,410     | $\frac{4.083}{152}$ | $\frac{3.985}{219}$ | 92<br>101                  | $\frac{120}{109}$                                  |
| Scrapers   |        | 46         | 39         | 1313        | 19                  | 29                  | 5                          |  |
| Pit-car loaders                                      |        | 17         | 12         | (1)         | (1)                 | (1)                 | (2)                        | (2)  |
| Conveyors equipped with duckbills or other self-     |        |            |            |             |                     |                     |                            |  |
| loading heads  | 1.632  | 1.483      | 1.329      | 1,242       | 1.049               | 849                 | (3)                        | (3)  |
| Hand-loaded room conveyors, number of units.         | 4.125  | 4.312      | 4.434      | 3.904       | 3,569               | 2,994               | 61                         | 143  |
| Anthracite mines (Pennsylvania):                     |        |            |            |             |                     |                     |                            |  |
| Mobile loading machines                              | 19     | 27         | 30         | 43          | 54                  | 39                  | 17                         | 1  |
| Continuous mining machines                           |        |            |            |             |                     |                     | 1                          |  |
| Scrapers   |        | 589        | 556        | 528         | 456                 | 489                 |                            | 2  |
| Hand-loaded room conveyors, number of units          | 3.562  | 3.618      | 3.460      | 3.282       | 3.232               | 2.784               | 24                         | 7  |

Canvass of pit-car loaders was discontinued in 1951.

Canvass of sales of pit-car loaders discontinued in 1945.

Canvass of sales of conveyors equipped with duckbills or other self-loading heads are included with hand-loaded room conveyors.

Includes pit-car loaders and conveyors equipped with duckbills or other self-loading heads.

all coal mines in the United States, 1950-55, inclusive. Shipments of all types of mechanical loading equipment, except scraper loaders, increased in 1955 from 1954. Shipments of shuttle cars, mother conveyors and room or transfer conveyors increased in 1955 from 1954, but face conveyors decreased during the same period.

Exports of underground mechanical loading equipment in 1955, in terms of capacity, amounted to nine percent of the shipments to mines in the United States compared with six percent in 1954.

Types of mechanical loading equip-

ment sold compared with units in use. Table IV shows the trend in demand for various types of mechanical loading equipment. Mobile loading machines in use reached the maximum in 1951 at bituminous coal and lignite mines and in 1952 at Pennsylvania anthracite mines. However, the 1955 shipments of mobile loading machines were only three percent of the number in use in 1953 at both bituminous coal and lignite mines and Pennsylvania anthracite mines.

Table V shows the number of mechanical loading units and coal recovery augers shipped to various

States in 1954 and 1955 compared with the number in use in 1953, as reported by mine operators. Sales of room conveyors as listed in table V are not exactly comparable with the number of room conveyors in use. To avoid duplication in tonnage mechanically loaded, the mine operator was instructed to report "hand-loaded" and "self-loading" conveyor tonnage only; therefore, room conveyors loaded by mobile loaders are not included with "Room conveyors in use in 1953." Shipments of coal recovery augers in 1954 and 1955 were greater than the total number in use in 1953.

TABLE V—MECHANICAL LOADING AND MINING EQUIPMENT IN USE IN 1953, BY STATES, COMPARED WITH SALES REPORTED IN 1954-55

|  | SALES REPORTED IN 1801-03 |              |     |                      |                               |     |                      |             |           |                      |                                |       |                      |                        |       |  |
|--|---------------------------|--------------|-----|----------------------|-------------------------------|-----|----------------------|-------------|-----------|----------------------|--------------------------------|-------|----------------------|------------------------|-------|--|
|  | Mobile                    | loadir       | ng  |                      | Continuous<br>nining machines |     |                      | Scrapers    |           |                      | Room<br>conveyors <sup>1</sup> |       |                      | Coal recovery . augers |       |  |
| State                                    | In use<br>in<br>1953      | Sale<br>1954 |     | In use<br>in<br>1953 | Sal<br>1954                   |     | In use<br>in<br>1953 | Sal<br>1954 |           | In use<br>in<br>1953 | Sal<br>1954                    |       | In use<br>in<br>1953 | Sa<br>1954             |       |  |
| Bituminous coal<br>and lignite<br>mines: |                           |              |     |                      |                               |     |                      |             |           |                      |                                |       |                      |                        |       |  |
| Alabama                                  | 123                       | 12           | 2   | 8                    | 2                             |     |                      |             |           | 137                  | 1                              | -1    |                      | 1                      |       |  |
| Alaska                                   | 3                         | 2            |     |                      | 2 2                           |     | 10                   |             |           | 3                    | 3                              |       |                      |                        |       |  |
| Arkansas                                 |                           |              |     |                      |                               |     |                      |             |           | 64                   |                                |       |                      |                        |       |  |
| Colorado                                 | 36                        | 1            |     | 5                    |                               |     |                      | 1           |           | 211                  |                                |       |                      |                        | 1     |  |
| Illinois                                 | 309                       | 1            | 1   | 20                   | 6                             | 7   |                      |             |           | 13                   |                                |       |                      |                        | 1     |  |
| Indiana                                  | 107                       | 1            | 1   |                      |                               |     |                      |             | * + *     | 111                  |                                |       |                      |                        |       |  |
| Iowa                                     | 2                         |              |     | 7.5                  |                               |     |                      |             | V - V - V | 1                    |                                |       |                      | 195                    |       |  |
| Kentucky                                 | 471                       | 17           | 27  | 13                   |                               | - 6 | 0.6 8                |             |           | 526                  | 15                             | 28    | 4                    | 10                     | 11    |  |
| Maryland                                 |                           |              |     |                      |                               | 100 | 4 4 5                |             |           | 12                   | 1                              |       | 3                    |                        |       |  |
| Montana                                  | 31                        | 1.4          |     |                      |                               |     | 111                  |             | ****      | 6                    |                                |       |                      | 200                    |       |  |
| New Mexico                               | 16                        |              |     |                      |                               | 200 | 4                    |             | 2.5.4     | 2                    | 4 4 2                          |       |                      | 4 4 4                  |       |  |
| North Dakota                             | 4                         |              |     | 1.7                  | 4                             |     | 0.00                 | 4.4.4       | * + *     |                      | 1.00                           |       |                      | 40                     | ***   |  |
| Ohio                                     | 164                       |              |     | 17                   | 1                             | 4   | ***                  | 9.4.1       | * * *     | 58                   | 1                              | 7     | 10                   | 12                     | 5     |  |
| Oklahoma                                 | 5                         |              | 17  | 112                  | 38                            | 50  |                      | 9           | * * *     | 127                  |                                | 10    | 7                    |                        | 8     |  |
| Pennsylvania                             | 927<br>28                 | 5            | - 0 | 112                  | 99                            | 90  | 9                    | 2           |           | 666<br>54            |                                | 12    | 3                    | 9                      |       |  |
| Tennessee                                | 123                       | 5            | 3   | 9                    | 3                             | 5   |                      | 11.5        | * * *     | 45                   |                                | * * * | 9                    |                        | * * * |  |
| 771 1 1                                  | 144                       | 11           | 14  | $\frac{2}{2}$        | 2                             | 9   |                      | 1 4 9       |           | 119                  | 10                             | 17    | 3                    | 1                      | 6     |  |
| 337 1 1                                  |                           |              | -   | 6                    |                               | 1   | 6                    |             |           | 95                   |                                | -     |                      | 1                      |       |  |
| West Virginia                            | 1.456                     | 37           | 52  | 32                   | 47                            | 27  |                      |             |           | 1.496                | 30                             | 75    | 64                   | 22                     | 35    |  |
|  | 36                        | -            |     | 2                    |                               |     |                      | 2           |           | 208                  |                                |       |                      |                        |       |  |
|  | 90                        |              |     | _                    | 177                           |     |                      | _           |           |                      |                                | * * * |                      | 10.8.4                 |       |  |
| Total bituminous coal and lignite        | 3,985                     | 92           | 120 | 219                  | 101                           | 109 | 29                   | 5           |           | 3,843                | 61                             | 143   | 94                   | 55                     | 65    |  |
| Anthracite mines<br>(Pennsylvania)       | 39                        | 17           | 1   |                      | 1                             |     | 489                  |             | 2         | $2,784^{2}$          | 24                             | 7     |                      |                        | 1     |  |
| Grand total                              | 4,024                     | 109          | 121 | 219                  | 102                           | 109 | 518                  | 5           | 2         | 6,627                | 85                             | 150   | 94                   | 55                     | 66    |  |

 $^{\rm l}$  Includes hand-loaded conveyors and conveyors equipped with duckbills or other self-loading heads.  $^{\rm l}$  Includes also pit car loaders.

#### Haulage Equipment

Shuttle cars. Sales of shuttle cars increased from 256 in 1954 to 356 in 1955. Details of shipments to various States in 1954 and 1955 are given in table VI. There were 4222 shuttle cars in use in bituminous coal and lignite mines in 1953. Details of the number of cable-reel and battery-type shuttle cars in use, by States, 1952-53, inclusive, are given in table 20, Bureau of Mines Mineral Market Summary 2339. Exports of shuttle cars were the same in 1955 as 1954.

Face conveyors. A face conveyor is 10 to 100 ft in length and is used parallel to the face of the room to move material along the face to a room conveyor. Table III lists total sales, 1950-55, inclusive, and table VI lists sales, by States, for 1954 and 1955. Data on the number in use are not available.

"Mother" conveyors. For the purpose of this study a "mother" conveyor is defined as a sectional, extensible, power-driven conveying unit that can handle over 500 ft of conveyor. Main-slope conveyors are excluded. Table III lists sales for 1950-55, inclusive, and table VI shows shipments by States in 1954 and 1955. In 1953, 322 bituminous coal mines used 304 miles of "mother" conveyors. Detailed data by States on "mother"



Shuttle car sales increased 39 percent over 1954

TABLE VI—UNITS OF CONVEYING EQUIPMENT SOLD FOR USE IN COAL MINES, 1954-55, BY STATES

|                                 | Fa   | ce<br>eyors <sup>1</sup> | Shut | ttle | "Mother"<br>conveyors2 |      |  |
|---------------------------------|------|--------------------------|------|------|------------------------|------|--|
| State                           | 1954 | 1955                     | 1954 | 1955 | 1954                   | 1955 |  |
| Bituminous coal and lignite     |      |                          |      |      |                        |      |  |
| mines:                          |      |                          |      |      |                        |      |  |
| Alabama                         |      | 2                        | 26   | 17   |                        | 3    |  |
| Colorado                        |      |                          |      | 2    | 1                      |      |  |
| Illinois                        |      |                          | 1    | 12   | 6                      | 1    |  |
| Indiana                         |      |                          | 2    | 3    | 2                      | 1    |  |
| Kentucky                        | 23   | 24                       | 36   | 45   |                        | 8    |  |
| Maryland                        | 1    |                          |      |      |                        |      |  |
| Ohio                            |      |                          |      |      | 1                      | 7    |  |
| Pennsylvania                    |      | 14                       | 42   | 96   | 3                      | 27   |  |
| Tennessee                       |      |                          |      | 2    | * * *                  |      |  |
| Utah                            |      |                          | 8    | 13   | 1                      | 0    |  |
| Virginia                        | 14   | 2                        | 15   | 31   |                        |      |  |
| West Virginia                   | 77   | 34                       | 112  | 127  | 5                      | 23   |  |
|                                 |      | -                        |      |      |                        | -    |  |
| Total bituminous coal and       |      |                          |      |      |                        |      |  |
| lignite                         | 115  | 76                       | 242  | 348  | 19                     | 78   |  |
| Anthracite mines (Pennsylvania) | 11   |                          | 14   | 8    |                        | 3    |  |
| Grand total                     | 126  | 76                       | 256  | 356  | 19                     | 81   |  |

<sup>1</sup> Includes "bridge" conveyors and all other conveyors 10 to 100 ft long. <sup>2</sup> Includes all haulage conveyors with capacity over 500 ft, except main slope conveyors.

TABLE VII—BITUMINOUS COAL MECHANICALLY CLEANED IN 1953 COMPARED WITH SALES OF MECHANICAL CLEANING EQUIPMENT IN 1954-55, BY STATES

|               | Number<br>of<br>plants in<br>operation | 1953<br>Net tons<br>of<br>cleaned<br>coal | Output<br>mechanically<br>cleaned<br>(percent) | of e      | nnual<br>pacity<br>quipment<br>sold<br>t tons)1 |
|---------------|--|---|--|-----------|---|
| State         |  |   |  | 1954      | 1955  |
| Alabama       | 40                                     | 11,110,349                                | 88.7   |           | (2)   |
| Alaska        | 1                                      | 253,570                                   | 29.4   | (2)       |   |
| Colorado      | 5                                      | 1,618,150                                 | 45.3   | ******    | *******   |
| Illinois      | 69                                     | 35,456,970                                | 77.1   | 728,000   | 2,147,000                                       |
| Indiana       | . 24                                   | 12.650,620                                | 80.0   | (2)       |   |
| Kansas        | 4                                      | 1,238,187                                 | 72.2   | *******   |   |
| Kentucky      | 77                                     | 28,144,723                                | 43.3   | 937,000   | 3,822,000                                       |
| Missouri      |  | 2,156,543                                 | 90.1   | ******    |   |
| Montana       | . 2                                    | 45,035                                    | 2.4  |           |   |
| New Mexico    |  | 95,410                                    | 18.6   |           |   |
| Ohio          | . 25                                   | 13,576,190                                | 39.1   | (2)       |   |
| Oklahoma      | 4                                      | 623,469                                   | 28.8   |           |   |
| Pennsylvania  | . 89                                   | $48,776,471^{\circ}$                      | 52.3   | 1,738,000 | 1,052,000                                       |
| Tennessee     | . 9                                    | 535,462                                   | 9.8  | ******    |   |
| Utah          | . 6                                    | 2,540,571                                 | 38.8   | (2)       |   |
| Virginia      | . 30                                   | 7,372,207                                 | 38.6   | 541,000   | 1,198,000                                       |
| Washington    |  | 671,246                                   | 97.3   |           | (2)   |
| West Virginia | 204                                    | 74,893,4044                               | 55.8   | 3,930,000 | 7,415,000                                       |
| Undistributed |  |   |  | 537,000   | 761,000   |
| Total         | 611                                    | 241,758,577                               | 52.9   | 8,411,000 | 16,395,000                                      |

average days mines were active in 1953 and 7.0 hours per day. in "Undistributed."

Included in "Undistributed."

Includes some coal mined in Pennsylvania and cleaned in Ohio, and a small tonnage mined in other States and cleaned at a consumer-operated plant in Pennsylvania.

Includes some coal mined in West Virginia and cleaned in Pennsylvania.

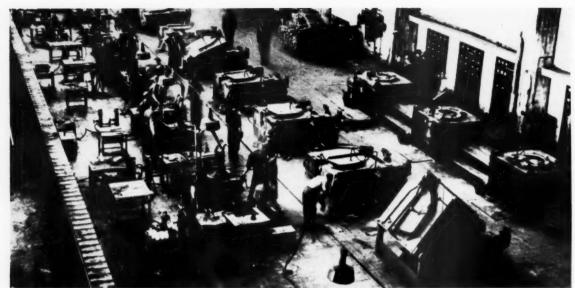
conveyors in use for 1945-53, inclusive, are given in table 21 of Bureau of Mines Mineral Market Summary 2339. Exports of "mother" conveyors decreased 85 percent in 1955 from 1954.

#### Mechanical Cleaning

Reports from 19 manufacturers of bituminous coal cleaning equipment show that the total capacity of 1955 sales was 12,610 net tons of clean coal per hour compared with 6230 tons of capacity sold in 1954. However, the annual capacity of 1955 sales, based on average days mines were active in the various States in 1953, showed an increase of 95 percent over 1954 sales. (See table VII) Sales in 1955, by type of equipment, in terms of capacity, show that dense medium ranked first, followed by jigs, and wet tables. The capacity of all types of equipment sold in 1955 for cleaning bituminous coal by wet methods was equivalent to seven percent of the bituminous coal cleaned by wet methods in 1953, and the capacity of pneumatic equipment sold in 1955 was five percent of the tonnage pneumatically cleaned in 1953. Approximately 44 percent of the total capacity of cleaning equipment sold in 1955 was for additions to present installations and the remainder, 56 percent, comprised new plants.

Table VII gives data on bituminous coal cleaned in 1953, by States, and the annual capacity of equipment sold in 1954 and 1955.





The Volkswagen magnesium foundry in Germany, one of the world's finest, produces more than 40 lb of magnesium of each Volkswagen car built

# Magnesium

Steady Growth in a Healthy Industry Is Marked by An Expanding Consumer Market

#### By JERRY SINGLETON

Executive Secretary
The Manganese Association

ONCE again the record for magnesium bears out the prediction made for it in the so-called Paley Report issued in 1950, for again in 1955, magnesium consumption has moved ahead—not dramatically but steadily, not in a single use spurt but in an across-the-board use pattern which holds assurance for the future.

#### **High Mill Shipments**

True, primary magnesium production is down some 13 or 14 percent. But, this was the first full year in which no stockpile was done, and production for one month was halved by labor difficulties. The year ended at a production rate not reached since early 1954. More importantly, mill shipments of wrought product for the year established a new high, topping 10,000 tons for the first time in the industry's history with shipments holding at a rate slightly above that of the 1952-53 Korean years. Total shipments of mill products for 1955

were more than 50 percent above those of 1954.

Shipments of cast magnesium for the year rose about ten percent in total. However, here the interesting observation is the fact that sand castings accounted for little of this gain (less than one percent) the major increases came in permanent mold and die castings, areas holding the greatest future potential for the metal.

#### New Developments

Fundamentally, the year was a routine one for magnesium. Technically, the highlight of 1955 probably was the introduction of the HK31 magnesium-thorium alloy which offers a product suited to aircraft and missile use in the 500-700°F supersonic range. Commercially, the high spot was generally felt to be the introduction of magnesium luggage—first truly mass consumer product to be backed by national advertising. Dramatically, the 1955 spotlight must be



The factors, forces and trends which influence the growth of magnesium have been analyzed by JERRY SINGLETON, executive secretary of the Magnesium Association. Mr. Singleton has been assistant to the president of the Pressed Metals Institute and prior to that an editor of publications in the paint and office equipment industries.

shared by the all-magnesium F86 jet fighter still undergoing tests at Wright Air Force Base and the widely disseminated, largely inaccurate reports of the part magnesium played in the flood disaster in Putnam, Connecticut.

One of the high points of the year 1955 was the Eleventh Annual Convention of The Magnesium Association held in New York City. Two firsts marked the meeting; (1) more than 500 technical personnel were registered and, (2) the program was presented by those who are incorporating magnesium in their products rather than by those whose primary interest was selling magnesium in one of its forms.

#### Markets

Naturally, greatest interest among those who are a part of the magnesium industry is in those areas of use which are developing. In this phase 1955 was also a good year. For the first time in its relatively brief history the major portion of magnesium product was for non-military usesindustry and the ultimate consumer moved ahead. Magnesium as a structural metal moved into the truck body business. Magnesium ladders won wider markets and a full page of display in the Sears-Roebuck catalog. Materials handling equipment from dollies to huge yard ramps were winning increased recognition and acceptance. Magnesium use in cathodic protection, from water heaters to ships at sea and steel mills on land, was calling for increased tonnage. Then too, the chemical and metallurgical uses for magnesium are rapidly growing markets as it is essential to aluminum, titanium, uranium and beryllium.

Technological progress has added to current markets and has spearheaded investigations which hold great promise for the future. Hot chamber U. S. MAGNESIUM SHIPMENTS-1952-1955 (Short Tons)

|             | Sand   | Castings<br>Perm. Mold | Die    | Totals  | Wrought<br>Products | Primary<br>Ingot<br>Production |
|-------------|--------|------------------------|--------|---------|---------------------|--------------------------------|
| 1952 Totals | (No    | Breakdown)             |        | 17.428  | 9.125               | 105.821                        |
| 1953 Totals | 11.584 | 2,658                  | 3.057  | 17,299  | 8.443               | 93,075                         |
| 1954 Totals | 8,020  | 2,333                  | 2,414  | 12,767  | 6,946               | 69,723                         |
| January     | 723    | 173                    | 256    | 1,152   | 888                 | 5,089                          |
| February    | 642    | 243                    | 194    | 1,080   | 824                 | 4.646                          |
| March       | 779    | 226                    | 281    | 1,286   | 973                 | 4,942                          |
| April       | 763    | 297                    | 256    | 1,316   | 878                 | 1.859                          |
| May         | 638    | 330                    | 232    | 1,200   | 918                 | 4,277                          |
| June        | 686    | 252                    | 245    | 1.183   | 839                 | 4.757                          |
| July        | 491    | 286                    | 183    | 960     | 718                 | 5,112                          |
| August      | 596    | 225                    | 267    | 1.088   | 871                 | 5,880                          |
| September   | 644    | 360                    | 235    | 1,239   | 1.079               | 5,923                          |
| October     | 633    | 236                    | 282    | 1.151   | 833                 | 6.286                          |
| November    | 650*   |                        | 250*   | 1.150*  | 977                 | 6.130                          |
| December    | 700*   | 250*                   | 250*   | 1,200*  | 850*                | 6,100*                         |
| 1955 Totals | 7,945* | 3,128*                 | 2,931* | 14,005* | 10.648=             | 61,001*                        |

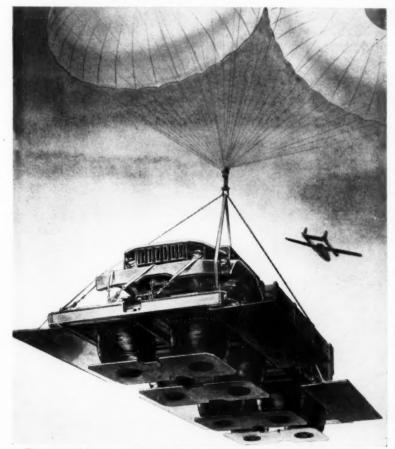
die-casting of magnesium has created interest and spurred experimentation in entirely new fields of application. Plaster molding techniques, improved finishes and the potential inherent in the heavy presses of the aircraft program have combined to arouse interest of cost-conscious designers and

engineers, creating a greater number of inquiries and a greater opportunity to bid on jobs where magnesium is, or may be, a satisfactory alternative material. Designers and engineers likewise are giving greater recognition to the desirable working characteristics of magnesium and again, are finding important labor and dollar savings.

#### **Price Rises**

Magnesium along with all metals has increased in price during the year just past. Pig magnesium f.o.b. Velasco, Tex., opened 1955 at 27 cents per pound and ended the year at 32.54 cents. However, this has been no greater—percentagewise—than competitive metals. There was one basic change made in pricing, the introduction of a dual pricing system with a differential of two cents per pound between metal designed for magnesium end usage and that for chemical and metallurgical use—in other words where its identity will be lost.

As 1956 opens, the industry looks forward to a continued growth-a steady growth predicated upon selling effort and buyer acceptance. potential in the electronics field has only been scratched. Potential applications in material handling still are being discovered. The potential contribution of magnesium to portability of tools, jigs, fixtures and other inplant equipment is only now being realized. Growth of magnesium applications in the graphic arts is amazing. Finally, the demands of the Department of Defense for ordnance, armament and material which is serviceable yet can be air borne without weight penalty are opening doors to the lightest structural metal which would seem to assure the industry's good health for as long as our defense establishment is a requirement of national survival.



The potential future applications of magnesium are only as limited as human imagination



Most gold is mined underground at high labor cost

# Gold in 1955

In Periods of High Prosperity the Public is Unconcerned About Changes in the Value of Money

By ROBERT W. BACHELOR

A. M. Kidder Co.

THE past year was one of unprecedented economic prosperity in nearly every country of the world. There was general full employment with substantial incomes; and wholesale and consumers' prices were steady in most industrial countries for which reliable indexes are published. As a consequence the public generally was little concerned about changes in the value of money, or its use as a store of value-subjects that were of much concern to them during most years of the past decade. The price of gold on free markets declined from a slight premium at the beginning of the year to approximately its monetary value in November and December.

#### **Production of Gold**

Based upon monthly reports, gold production of the world is estimated to have set a new post-war record of more than \$950,000,000 in value, an increase of four percent over the \$910,000,000 production of 1954, and ten percent above the total of \$860,000,000 produced in 1953.

Production in the Union of South Africa was valued at \$500,000,000. This was more than half of the world total, excluding the USSR and represented an increase of more than eight percent. It accounted for all of the net increase for the world outside the USSR. About three-fourths of the



From 1929 until 1935 ROBERT W. BACHELOR was economist for the Federal Reserve Bank of San Francisco. The next three years were spent as economist for the United States Tariff Commission, after which he became a director of research for the American Bankers Association. He is now head of the research department for A. M. Kidder & Co., director of research for the Bay Foundation, and director of the American Export Lines, Inc. Mr. Bachelor is author of numerous articles on banking, finance, money, and investmen's.

increase came from Orange Free State mines, while new mines in the Transvaal provided 20 percent. Gold mines in the Orange Free State absorbed all of the increase in native mine employment, and labor shortages of skilled and unskilled miners were reported.

There appears to have been a slight decline in United States production, which was about offset by increased sales from Canadian mines. Most other countries reported the same or slightly lower output of gold compared with 1954.

The year was a record for the production of nearly every kind of metal in most countries. Demand continually exceeded the supply available at existing prices. Prices of most metals increased steadily throughout the year or were traded to some extent at premium prices. Since gold in small quantities is associated in ores with many other metals it would seem unusual if gold output did not equal or exceed production for any recent year. Thus it is surprising that world gold production in 1955 increased only about four percent, and decreased in the United States. Mid-year labor disputes at copper mines in North and South America reduced the amount of gold recovered as a byproduct.

The Union of South Africa, Canada, and the United States now produce the majority of the world's Their combined output represented 75 percent of world gold production, excluding the USSR, in 1954. Production in South Africa was increased substantially in 1955 as increased revenues became available from the recovery of uranium. This increased income, available for several recent years, has stimulated the opening of new mines and the processing of marginal ores. Production in Canada increased slightly. Canadian producers have had the benefit of a subsidy system to some extent graduated according to costs of production. An alternative was the right to sell gold on free markets. Exploration work now under way in Canada may result in greater production in future years.

Gold production in the United States declined slightly as it has since 1953. United States producers have not been able to sell gold on premium markets or to receive subsidies. As a result of the squeeze between rising costs and a fixed price for their product, operators have not been active in adding to their facilities for recovering gold. However, a substantial number of gold operators

#### -SILVER REVIEW IN MARCH-

The annual review on Silver will be carried as a feature in the March issue of Mining Congress Journal. It is being held in order to allow inclusion of final yearend figures. The author is an outstanding leader in industry whose report will be complete and authoritative in all respects.

have expanded their exploration for and production of other non-ferrous metals including uranium, and have increased their interest in non-metallic minerals such as petroleum.

#### Price of Gold

Notwithstanding the continuance of the cold war and threats of hot wars in various parts of the world, the free market price of gold, in most countries outside the United States where such transactions are legal and customary, declined from a slight

premium above monetary values at the beginning of the year to no premium for gold bars at the end of the year. The premium on gold coins also decreased in proportion, indicating much less interest in hoarding on the part of people of small financial means. The greatest premiums for gold continue in the Far East where climate and other factors make the use of paper currency unsatisfactory; and lack of a widespread banking system has discouraged the use of checks as a medium of exchange.

The reopening of the London gold market on March 22, 1954 strengthened the facilities required to make gold available to the public. Other countries followed. On December 30, 1955 Belgium and Luxembourg abolished all restrictions upon the sale, import or export of gold.

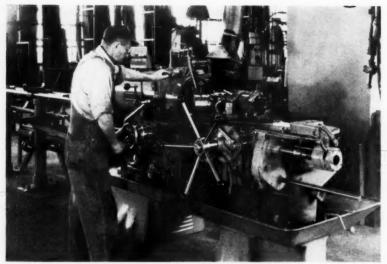
The Bank for International Settlements has calculated that with the fixed United States buying and selling prices for gold of \$34.9125 and \$35.0875, the maximum dollar price of gold in London will be about \$35.24. During 1955 the price has been below this figure and has fluctuated on a monthly average basis between \$35.11 and \$35.03.

#### **Monetary Reserves of Gold**

Gold reserves of central banks and governments (excluding the USSR) increased \$520 million during the first nine months of 1955 compared with production of perhaps \$700 million. Thus three-fourths of all new gold went into monetary stocks and only one-fourth was absorbed in jewelry and hoards-a smaller percentage than has been recorded in any postwar year. For the years 1946-1954, 55 percent of aggregate gold production was accounted for by industrial use or private hoarding. Monetary reserves decreased slightly during the year in the United States and United Kingdom. There were increases in Canada and in several European countries including Belgium and Germany. These conventional statistics undoubtedly give only a fragmentary picture of all gold dealings in 1955 since it is known that the USSR made large sales of gold in free markets, including London, in both 1955 and 1954. Substantial amounts of Soviet gold appeared in the West toward the end of 1953 and the free price quickly dropped close to the official United States price, and has stayed there with moderate fluctuations from time to time. The magnitude of Soviet sales is not known but has been variously estimated at from one million to three and onehalf million ounces for 1955. This latter figure would have a value equal to about one-eighth of all new gold produced outside the USSR in 1955.



Model layout of a proposed gold mine of the Anglo American Corp. in the Orange Free State



Turret lathe in the drill shop of Homestake Mining Co.

#### **Balance of Gold Payments**

Gold and United States dollar reserves of foreign countries increased \$900 million in the first six months of 1955 compared to an increase of \$440 million in gold during the same period.

The gold stock of the United States was almost unchanged during the year. Increases from imports and purchases of domestic newly-mined gold were almost exactly offset by increased earmarkings of gold for foreign account.

The international balance of payments normally requires a substantial amount of gold in settlements between central banks and governments. However, for many of the post-war years, balance of payments deficits have been settled by grants from the United States either in dollars or other currencies, under a variety of foreign aid programs. For the first six months of 1955 foreign purchases and acquisitions of assets in the United States of \$10.7 billion were supported by \$2.7 billion of United States government grants, loans and military expenditures abroad.

#### Efforts to Increase the Monetary Price of Gold

In September 1955 at the annual meeting of the International Monetary Fund at Istanbul, a determined effort was made by representatives of South Africa, Australia, and other important producers of gold, to obtain action that would have resulted in a higher monetary value for gold. It was pointed out that with the huge increase in international trade and financial obligations, present gold reserves are insufficient to provide liquidity in settlements. The British Chancellor of the Exchequer was emphatic in supporting the stand of

South Africa and others, but made it clear that the timing for such a move must be right. He did not indicate when the time might be right. This bid for revaluation was strongly opposed by representatives of the United States who expressed fears of a further round of inflation if gold were revalued. It would seem that they might have considered the present world wide inflationary tendencies to be in part due to the lack of a visible connection between key currencies and gold.

This was one of the most significant attempts to raise the price of gold, on an international level. In past years, South Africa and other countries, by unilateral action, have been able to force the International Monetary Fund to withdraw objec-

tions to the maintenance of subsidies and premium markets for newly-mined gold. Perhaps continued agitation will eventually be effective in securing agreement to revalue gold. This now seems more feasible, since during 1953, 1954 and 1955 the United States has been a net seller of gold, in contrast to her huge purchases of gold during the early 1940's, when she literally made a market for the gold of the world.

#### Outlook

It has become evident during the post-war inflationary years that gold production has increasingly proached either a byproduct operation where one or more other minerals afford sufficient income to offset the marginal nature of gold mining; or gold mining has been continued as a matter of national policy, supported in part by subsidies or the right to sell gold at a free market price. Most domestic currencies throughout the world have tended toward a declining use of metallic money and a greater reliance on paper currency and bank deposits secured by debts either of governments or of private borrowers.

The outlook for a higher price for gold in 1956 is not good. Such an increase probably must await an increase in hoarding which usually accompanies wars and rumors of wars; or a downturn in economic activity and employment in the industrialized countries of Europe and America, for which practical politicians would prescribe a massive dose of inflation, administered in a dramatic manner, by international agreement. The price of gold is fixed politically and changes sometimes follow a long way behind forces of the market.

#### Molybdenum

(Continued from page 137)

menting with them in many other fields including plastics. Molybdenum pigments and toners are well established in the paint and printing ink industries where still additional growth may be expected. New and enthusiastic interest is developing in the field of intermetallics for materials which can withstand the stress, strain and corrosion of ultra-high temperatures. Although still in early developmental stages, molybdenum borides, carbides and silicides will bear watching in years to come.

#### **Future Outlook**

With increased consumption of molybdenum by the iron and steel industry virtually certain, with foreign demand definitely on the increase and with non-metallurgical consumption promising, molybdenum producers view the future confident in their ability successfully to supply growing demands.

Although 1955 molybdenum production hit a peacetime peak, the producers were not able to put forth their best effort mainly because by-product or so-called secondary production was halted for more than a month by work stoppages. The supply picture is expected to improve this year and for the next few years to come. The major stockpile contract between Climax Molybdenum Company and the Federal Government has terminated, freeing a considerable amount of "moly" for industry. The installation of a new milling unit at the Climax, Colo., mine late in 1956 will permit some additional production, should the need arise. In addition, the opening of the San Manuel mine in Arizona will raise by-product production by increasing amounts for the next two or three years. And so, as industry finds new ways to put "moly" to work, producers are finding ways to keep supply in balance with demand.

# Rewinding a Mine Hoist Motor

. . . a typical page from the casebook of National service to the mining industry







When this reversing mine hoist motor failed, its owners asked National to redesign and rewind it for maximum increase in horsepower.

Figure 1 shows rotor damage from a short circuit caused by a loose bolt within the laminations. Consequential damage to the stator is shown in Figure 2.

Work done on this machine included partial

restacking of laminations on the rotor core, partial replacement of finger plates, complete rewinding of both rotor and stator and encapsulation of rotor clips to prevent relative movement, to insulate them and to protect them from corrosion.

Figure 3 shows installation of the new rotor winding on the repaired core and Figure 4 shows the stator winding prior to connecting.







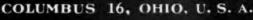


Dynamic balancing of rotating elements after rewinding, standard procedure at National, is illustrated in Figure 5. Figures 6 and 7 show the rewound rotor and stator ready for return to the mine.

Looks a little different—and it is, too. By redesign of inductors, use of new insulating materials and other improvements, National engineers increased the capacity of the motor from 2500 to 3200 HP.

Unusual case? No, just a typical example of what National can do. That's why you should invite your nearby National field engineer to tell you all about National services — why you should think of National first when you have a problem with any large rotating electrical equipment.

# NATIONAL ELECTRIC COIL COMPANY





ELECTRICAL ENGINEERS: MAKERS OF ELECTRICAL COILS AND INSULATION— REDESIGNING AND REPAIRING OF ROTATING ELECTRICAL MACHINES



Cincinnati in the spring from across the Ohio River

# 1956 Coal Convention May 7 - 9

# Trends in Modern Mining to Be Theme at Annual Meeting of the Coal Industry

VIRTUALLY every facet of modern coal mining techniques will be studied at morning and afternoon sessions of the 1956 Coal Convention of the American Mining Congress in Cincinnati, Ohio, May 7-9. With coal production and sales definitely on the upgrade, a record attendance of coal mining men is expected to take advantage of the opportunity to learn about the latest developments in their highly mechanized industry.

The Program Committee, under the chairmanship of G. A. Shoemaker, executive vice-president, Pittsburgh Consolidation Coal Co., has worked out a well-balanced program covering all phases of underground and strip coal mining and coal preparation with acknowledged experts participating in each session. In addition to the coal miners, men in the metal and nonmetallic mining fields will also find many of the papers of marked value to them, in the constant battle to boost production while paring costs.

#### **Luncheon Speakers**

The future of atomic energy and its ultimate effect upon the once-again forward-moving coal mining industry will be featured at a luncheon on the opening day of the Convention. Philip E. Sporn, president

of American Gas & Electric Co., a leading coal-fired electric utility, will give his views on this important subject in a speech on "Future Energy Resources."

An unrelated theme will be featured at a luncheon meeting the next day, when the well-known sports columnist, Red Smith, will give Convention-goers an insight on the nation's sport scene, a planned change of pace from the serious side of this year's AMC Coal Convention.

#### **Entertainment Tops**

The traditional Coal Miners Party will be held Monday evening. It promises to be another gala affair designed to satisfy to the fullest the appetites of the many Convention visitors for food, frolic, and fun. Nobody will want to miss the outstanding program of entertainment in store for them at this event.

Big attraction of Tuesday night will be major league baseball at Crosley Field. Tickets are available from the Cincinnati Baseball Club Co., 307 Vine St., Cincinnati, Ohio. To those who are not interested in the national sport, Cincinnati offers a wide variety of other types of entertainment convenient to the downtown area.

The biennial Coal Banquet will

climax the convention on Wednesday evening. This will again be a "speechless" banquet, with only brief introductions of honored guests. As in past years, topnotch "name" entertainment will be offered.

#### Fine Women's Program

An outstanding program is being planned for the hundreds of ladies who accompany their husbands to Cincinnati. There will be special luncheons and entertainment, which along with browsing in the many fine shops, will serve to keep the women busy while their men are occupied with business in the technical sessions. Girls, be sure your husbands make plans right now to be in Cincinnati, and that they bring you so neither of you will miss anything!

Please make your room reservations directly with Cincinnati's hotels—the sooner the better. The Cincinnati Convention & Visitors Bureau, Inc., Union Central Bldg., Cincinnati, Ohio (telephone PArkway 3728) will be glad to assist in securing accommodations.

Further details on this "must" Convention for coal mining men will be carried in next month's issue of Mining Congress Journal, Watch for it!

### Preliminary Program=

#### MONDAY, MAY 7

#### 10:00 am-Opening Session

A practical Look into Coal's Future
R. E. SALVATI, Island Creek Coal Co.

The Railroads and Coal Industry
W. W. PATCHELL, Pennsylvania Railroad Co.

#### 12:00 noon-Luncheon

Address: Future Energy Sources
PHILIP SPORN, American Gas and Electric Service

#### 2:15 pm-Strip Mining Session

Engineering Development and Economics of the 60-Yard-Shovel JAMES HYSLOP, Hanna Coal Co.

Time Study on Stripping Shovels
WILLIAM W. YOUNGBLOOD, Midland Electric Coal
Corp.

Truck Haulage with Large and Small Units
W. C. SPENCER, Pittsburg & Midway Coal Mining Co.

#### 2:15 pm-Maintenance Session

A Modern Maintenance Organization
DONALD B. SHUPE, Eastern Gas and Fuel Associates

Mine Lighting Improves Safety and Maintenance S. P. CARTER, Coal Div., Armco Steel Corp.

Maintenance of Fans and Power Conversion Equipment
B. R. WALBURN, Vesta-Shannopin Div., J & L Steel
Corp.

#### **TUESDAY, MAY 8**

#### 10:00 am—Continuous Mining Session

Continuous Mining with Extensible Belts
MICHAEL YONKO, Powhatan Mining Co.

Continuous Mining in Low Coal
E. M. PACE, Inland Steel Co.

E. M. PACE, Inland Steel Co. Five Years of Continuous Mining

ROBERT BILLINGS, Rochester & Pittsburgh Coal Co.
Subject and Speakers to be Announced

#### 10:00 am—Coal Preparation Session

Washery Water Clarification to Prevent Stream Polution MATTHEW TURKOVICH, Island Creek Coal Co.

The Joanne Cleaning Plant
C. C. CORNELIUS, Baton Coal Co.

Barge Loading Systems
D. H. McFADDEN, Ayshire Collieries Corp.

#### 12:15 pm-Luncheon

Address: Subject to Be Announced
RED SMITH, Sports Columnist

#### 2:15 pm-Roof Support Session

Pillar Mining Making High Recovery
H. A. CASSELL, Pocahontas Fuel Co.

Symposium on Roof Bolting

ROBERT FLETCHER, J. H. Fletcher and Co.
M. E. PRUNTY, Consolidation Coal Co. (Ky.)
E. M. THOMAS, U. S. Bureau of Mines
WILLIAM MCCULLOUGH, Snow Hill Coal Corp.

#### 2:15 pm—Industrial Engineering Session

Industrial Engineering and Cost Controls

(a) An Executive Viewpoint

H. E. JONES, JR., Amherst Coal Co.(b) An Operating Viewpoint

RALPH B. DEAN, Lorado Coal Mining Co.

An Analysis of Industrial Engineering as Applied to Coal Mining JOHN H. GOOCH, Ingle Coal Co.

#### WEDNESDAY, MAY 9

#### 10:00 am-Coal Preparation Session

Salvaging Coal from Washery Rejects
H. L. BEATTIE, Elk River Coal and Lumber Co.

The Corbin, Kentucky, Cleaning Plant
ANDREW E. HAMLET, Coal Div., U. S. Steel Corp.

The Buckheart Preparation Plant
ANDREW GABER, United Electric Coal Companies

#### 10:00 am—Haulage and Power Session

Fire Resistant Conveyor Belts

J. L. THORNTON, Goodyear Tire and Rubber Co. J. H. NASH, Ensign Electric and Manufacturing Co. S. P. POLACK, U. S. Bureau of Mines

Automation of Main Haulage

W. R. MORTON, General Electric Co. Trends in Underground Power

F. R. SELL, West Penn Power Co. C. B. Peck, Jr., Anaconda Wire and Cable Co.

#### 2:00 pm-Continuous Mining Session

Continuous Mining in Medium Height Coal FRANK WILLIAMS, JR., Peck's Run Coal Co.

Pillar Extraction with Continuous Mining in High Coal JOE TAYLOR, Kaiser Steel Corp.

Power for Continuous Mining
J. O. CREE, West Virginia Engineering Co.

#### 2:00 pm—Strip Mining Session

Haulage Roads for Strip Mining
R. I. RICHARDSON, Dakota Collieries Co.

Drilling and Blasting Overburden and Coal
ARNOLD E. LAMM, Sunnyhill Coal Co.

Maintenance of Strip Mine Equipment
WILLIAM C. M. BUTLER, JR., Central Penn Quarry
Stripping and Construction Co.
Representative of Truax-Traer Coal Co.



# Wheels of GOVERNM



#### As Viewed by HARRY L. MOFFETT of the American Mining Congress

THE Administration's major legislative goals have been laid before Congress in a series of messages from the President. The White House proposals unleashed a drive by the opposition party on Capitol Hill to revise most of them sharply to accord with its views on voter-appeal in this election year.

While the President is seeking changes in the Taft-Hartley Act, broader minimum wage coverage, and higher postal rates, it is likely that Congress will consign these proposals to the legislative limbo. His requests for broadened social security coverage and aid to education are headed for recasting to attract support at the polls.

The President submitted a budget for the 1957 fiscal year calling for total outlays of \$65.9 billion, the greater share of this being for national defense. He estimated that revenue receipts will be \$400 million above the estimated expenditures, which will provide little room for tax reduction. He predicted balanced budgets for both the 1956 and 1957 fiscal years and told Congress that a modest reduction of the national debt should be made before any consideration is given to tax cuts. Because of high industrial activity, revenue receipts may go beyond expectations, and lawmakers are awaiting the figures showing first quarter receipts before starting a drive for some reduction in individual income taxes.

Investigations of various Government agencies are being made by Congressional Committees. The Interior Department is under fire for granting mineral patents to the Al Sarena Mine. Proposals to amend the mining laws to reserve timber on mining claims to the Federal Government after patent may result from this investigation.

#### Military Land Withdrawals Scored

The House Interior and Insular Affairs Committee has started hearings, which promise to be extensive, into

policies of the Defense Department governing withdrawals of public lands for military purposes and the uses made by the military of the lands after they are carved out of the public domain.

Chairman Clair Engle (Dem., Calif.) said the hearings will probably result in the introduction of legislation to require the Defense Department to make full use of the lands withdrawn; to restore areas not being used by the military services; to provide for multiple use of the lands during periods they are not being used for military activities, and to require that Congressional approval be secured before further land withdrawals are made.

The hearings are an outgrowth of discussions at the Las Vegas meeting of the American Mining Congress and at the Western Governors Minerals Policies Conference at Sacramento last fall. At that time mining men complained of the huge withdrawals of public lands by the military services, the failure of the services to fully use the lands withdrawn, and the many pending applications which would remove large areas of the public domain from future mining location.

At the hearings, witnesses from the various military services testified that their total holdings are about 24.2 million acres, of which 11.8 million acres are from public domain lands, and 2.2 million acres are held under temporary use permits. They told the Committee that pending applications for public land withdrawals would remove an additional seven to 10 million acres from mining location or other use. Conflicting testimony was presented as to the policies governing military withdrawals. Some witnesses stated that all proposals for permanent land withdrawals were reviewed by the Defense Department while others said that only those with a value of \$25,000 or more were submitted for review before being submitted to the Interior Department. Questioning by Committee members brought out that the value of a public

#### Washington Highlights

MILITARY LAND WITHDRAWALS: Under investigation.

SILVER ACT: Repeal opposed.

METALS BARTER: On increase.

HIGHWAY PROGRAM: Pushed by President.

M.R.O.: OMM seeks data.

STOCKPILING: Funds cut.

RESIDUAL OIL: Imports to be in-

creased?

OTC: Headed for defeat.

NATURAL GAS: Debate under way. FREIGHT RATES: Increases opposed.

land withdrawal is determined by appraisals which are usually just "good guesses."

Further hearings by the Committee will go into present and pending military land withdrawals, on a case-bycase basis.

#### Silver Act Repeal Opposed

A Senate Banking and Currency subcommittee has concluded hearings on proposals to repeal existing legislation providing for Treasury acquisition of newly-mined domestic silver at a seigniorage charge of 30 percent of the \$1.29 coinage charge.

The hearings began last year and were continued to the present session at the request of Western Senators, who objected to the subcommittee's efforts to bring them to a close without hearing from the mining industry.

This past month the subcommittee heard several Senators from the West register strong opposition to the pending bill by Senator Green (Dem., R. I.). Senator Hayden (Dem., Ariz.) pointed up the beneficial effect that a stable silver market has upon the production of many base-metal ores and upon employment in the mining industry. He declared that the measure

would provide no benefit to the silver consuming industry since the world price of silver is above that paid by the Treasury to domestic producers. He urged the subcommittee to carefully consider the monetary role of silver in backing U. S. currency before taking any action so drastic as contemplated in the pending bill.

Senator Henry Dworshak (Rep., Idaho) also emphasized the role of silver in our monetary system and told the Committee that there is widespread misunderstanding, both in Congress and out, of the entire silver program. He strongly opposed the Green bill, pointing out that the silver acquisition laws had made possible the continued operation of many lead and zinc mines at a time when those metals were in a depressed state.

Another champion of the mining industry, Senator Allott (Rep., Colo.) told the Committee that if the Green bill were to be enacted many mines would be closed down and that many new ghost towns would result

throughout the West.

The American Mining Congress urged the Committee to reject the measure, and called for legislative action to recognize the increased costs of producing silver by reducing the seigniorage now charged by the Treasury. A large number of statements from mining industry organizations were also filed with the Committee voicing strong opposition to the bill.

Chairman Douglas (Dem., Ill.) of the subcommittee has not indicated when a report on the bill will be made to the full Banking and Currency Committee. Most Washington observers are of the opinion that the measure will be consigned to the legislative deep freeze for the remainder of the session.

#### Metals Barter on Increase

The Department of Agriculture's program for bartering surplus farm products with foreign nations for strategic materials will be stepped up. The Department reported that during the quarter ending September 30, 1955 strategic materials worth \$26 million were received in return for agricultural commodities, and that increasing quantities are expected.

The program is administered by the Commodity Credit Corporation, which has disclosed that it will barter farm products with foreign nations for aluminum, antimony, asbestos, bauxite, cobalt metal, copper, graphite, beryl, bismuth, cadmium, chromite, manganese, mica, nickel, platinum, selenium, and talc.

In his budget message the President pointed out that the Department of Agriculture is planning to increase its acquisition of strategic materials under the program during fiscal year 1957. He did not indicate what ma-

terials were added to the stockpile. Not all materials received go into the national stockpile; some are held by the Commodity Credit Corporation.

#### Highway Modernization Sought

In his State of the Union Message, President Eisenhower reiterated his request of last year for legislation to modernize the interstate highway system. He told the Congress that the need for such legislation is far more urgent than last year, and requested that funds be authorized to complete the proposed 40,000-mile road network over a 10 year period. Missing from this year's request was any recommendation for bond financing of the program. The President left the method of financing up to Congress, stating simply that "there must be an adequate plan of financing."

A number of measures have been tossed into the legislative hopper authorizing the construction program and providing that it be financed by increased taxes on gasoline, fuel oils, tires and tubes, but exempting non-highway users, such as the mining industry, from the proposed increases.

The outlook is for approval of a highway program at this session, although a stiff fight is in prospect as to any new taxes. Spearheading opposition to highway users' taxes are major trucking and oil interests.

#### MRO Data Sought

In an effort to bring up to date its data on the requirements of metal and nonmetallic mining companies for steel, copper and aluminum for maintenance, repair and operating supplies (MRO), the Office of Minerals Mobilization has had the U. S. Bureau of Mines distribute a form (OMM 1) to all companies on its commodity mailing lists, with the request that it be filled in and returned promptly.

This survey of MRO requirements is to be made only this one time, and OMM has emphasized the need of such data in order to assure adequate amounts of these critical metals for the mines in case of another national emergency. It is expected that a similar survey of MRO requirements will be made in the coal industry a little later.

#### Stockpiling Funds Cut

A drop in stockpiling outlays for the fiscal year 1957 was predicted by the President in submitting the new budget proposals. He told Congress that no new obligational authority for stockpiling would be needed and that net expenditures for stockpiling are expected to decline from \$713 million in 1956 to \$378 million in 1957. He pointed out that an increasing number of stockpiling objectives are being filled, and that the high level of

industrial activity has reduced the availability of some materials for stockpiling. The President said that no new obligational authority is being requested because sufficient authority is now available "for continued rapid progress toward completion of established minimum objectives and for limited procurement to maintain essential elements of the mobilization base."

At the same time the President emphasized the need for maintaining a sound domestic minerals industry. He said that the new budget recognizes the recommendations of the Cabinet Committee on Minerals Policy, and calls for expansion of investigations and research by the Bureau of Mines and the Geological Survey directed toward discovery of additional sources of essential minerals, improvements in mining techniques, and better utilization of mineral supplies. He also requested an appropriation of \$308,000 for the Office of Minerals Mobilization "to continue to develop and evaluate supply data for metals and minerals so that adequate supplies and production facilities will be assured for our national security and economic growth."

The budget message called for increased appropriations for the Atomic Energy Commission, and carried a ray of sunshine for the domestic uranium industry. The President told the Congress that greater quantities of uranium ores and concentrates will be purchased during the 1957 fiscal year. He did not, however, give any indication as to the possibility of extending the present purchase program beyond its scheduled termination date.

#### Increase in Oil Imports?

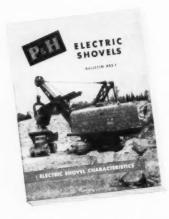
Indications that the Office of Defense Mobilization may be prodding oil importers to step up residual fuel oil imports during the first few months of this year were given in a letter sent to the importing companies by ODM Director Arthur Flemming in January.

Flemming requested the importers to advise whether they plan any added imports of residual fuel oil over and above those previously planned for the period mid-January through April 30. He asked them to indicate the amount of imports which "they feel may be required to meet current and prospective consumer demand" during this period. The information thus received is to be evaluated by the Cabinet Committee on Energy Supplies and Resources Policy, following which ODM will communicate further with the importing companies. The ODM letter has been generally interpreted as more than a gentle hint to the importers to in-

(Continued on page 168)

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The Philadelphia & Reading Corp., formerly the Philadelphia & Reading Coal & Iron Co., has announced the election of Howard A. Newman as president and chief executive officer. Edward G. Fox, president of the company since 1951, is now president of the Reading Anthracite Co., a whollyowned subsidiary, and a vice-president of the parent company.

Fhiladelphia & Reading, a leading producer of anthracite, recently began diversification. The company said the administrative changes reflected its new status and objectives as a diversified holding and management com-

pany.

Dr. E. T. Casler has been promoted to manager of the Florida operations of the phosphate minerals division of International Minerals & Chemical Corp. He replaces Floyd B. Bowen who was recently promoted to production manager of the phosphate minerals division's operations in Florida, Tennessee and Montana.

W. L. Zeigler, general manager of Pend Oreille Mines & Metals Co., Metaline Falls, Wash., has been appointed consultant to Bunker Hill & Sullivan Mining & Concentrating Co. He will continue with Pend Oreille as consultant and a director. Bunker Hill owns a 36 percent interest in Fend Oreille.

At the same time, Jens Jensen, Pend Oreille president, announced promotion of L. M. Kinney to resident manager at Metaline Falls. Loren G. Billings has been named superintendent.

George W. McCaa, general manager of the Jamison Coal & Coke operations, Pittsburgh Consolidation Coal Co., in Marion County, W. Va., was recently named general manager of Hanna Coal Co. in eastern Ohio. Hanna is also a unit of Pittsburgh Consolidation.

J. Luther Cleveland, chairman of the board of Guaranty Trust Co. of New York, was recently elected a director of The Anaconda Co. He succeeds William C. Potter, who had resigned.

Norman W. Long, formerly assistant chief engineer, Red Jacket Coal Corp., has been named sales engineer for Goodman Mfg. Co. Before going

with Red Jacket, Long had served in the engineering departments of Semet-Solvay Co. and Princess Dorothy Coal Co.

The appointment of L. W. Shelton as general purchasing agent of Kennecott Copper Corp. has been announced. Shelton, who has been serving as assistant general purchasing agent, succeeds R. Park Lamborn who reached retirement age on the first of the year. Lamborn will continue with the company in special assignments of an advisory nature.

W. K. Field, formerly purchasing agent of the corporation's Utah Copper Division, has been named to the position vacated by Shelton.

Associated with the Kennecott organization since 1923, Shelton spent many years in Chile as a



L. W. Shelton



R. P. Lamborn



W. K. Field

member of the staff of the company's subsidiary, Braden Copper Co. He was transferred to New York in 1947 to the position of assistant general purchasing agent.

Lamborn, who served in the Purchasing Departments of the company's Nevada and Utah Divisions prior to being named assistant to the general purchasing agent for Kennecott in 1930, was promoted to general purchasing agent in 1947.

Field was first employed at Kennecott's Nevada Mines Division in 1922 and was named purchasing agent of that division in 1948. In 1951, he was appointed purchasing agent of the Utah Copper Division.

Kefton H. Teague has joined the Industrial Minerals Division of International Minerals & Chemical Corp, as geologist.

E. E. McBurney was appointed general manager of mines of Jewell Ridge Coal Corp. and Jewell Eagle Coal Co. January 1. He joined Jewell Ridge in 1952 as chief industrial engineer and was made general superintendent of the Virginia mines in 1953. Early in 1955 he was named assistant to the vice-president from where he moved to general manager of mines.

J. Stanley Mitchell has been named plant superintendent at Calera Mining Co., cobalt refinery at Garfield, Utah. Mitchell joined Calera's parent company, the Howe Sound Co., in 1947 as mill superintendent in the Chelan (Washington) division.

Paul T. Allsman has been named chief mining engineer of the U. S. Bureau of Mines succeeding Eugene D. Gardner. A member of the Bureau since 1936, Allsman has been assistant regional director for metals and minerals of the 27-state eastern region. In his new position, he will be a staff advisor to all units of the Bureau in various fields of mine research and related activities.

J. A. Hunt, former president of the New River Co., has been named head of the newly - formed Winding Gulf Coals, Inc. Winding Gulf Coals was formed last October through a merger of four other coal producing firms in the Beckley, W. Va., area. Hunt succeeds W. P. Tams, Jr., who is retiring.

At the same time it was announced that W. A. Haslam has resigned as vice-president in charge of operations for New River Co. to become executive vice-president of Winding Gulf Coals.

Three production officials at the Climax, Colo., mine, Climax Molybdenum Co. have been advanced.

Edwin J. Eisenach, assistant general superintendent, was made general superintendent of the Climax Mining and milling operation. John M. Petty, mine superintendent, moved to the post of assistant general superintendent. William F. Distler was promoted from assistant mine superintendent to superintendent of the mines department.

James Phelan has been named chief of the Kentucky Department of Mines and Minerals by Kentucky Governor A. B. Chandler. Phelan succeeds A. D. Sisk who recently resigned.

William A. Todd was recently appointed manager of the mining department of the J. M. Longyear mining interests with headquarters at Marquette, Mich. He succeeded the late C. C. Hascall.

A retirement and two promotions in the engineering department of Universal Atlas Cement Co. were recently announced by Louis M. Funderburg, vice-president of the U. S. Steel Corp. subsidiary.

Raymond L. Walsh, assistant vicepresident and chief engineer, retired December 31 after 30 years of service, but is retained by the company in a consulting capacity. Chester D. Rugen is now assistant vice-president —engineering and Robert B. Jordan is chief engineer.

Sheldon P. Wimpfen, manager of the Atomic Energy Commission's Grand Junction Operations Office, Grand Junction, Colo., has resigned to become a vice-president of Glen Alden Corp.

Wimpfen was named manager of AEC's Grand Junction Operations

when that office was created in 1952 to consolidate the AEC's uranium programs on the Colorado plateau. After World War II he was assistant editor of the magazine Mining and Metallurgy until 1948, and was editor

of the MINING CONGRESS JOURNAL from 1948 until 1950, when he entered employment with the AEC. He was assistant director of the AEC's division of raw materials in Washington before becoming manager of the Grand Junction Office.

Wimpfen assumes his new post with Glen Alden on March 1, but continues as a consultant to the Atomic Energy Commission.

A. C. Butterworth, chief of the electrical-mechanical engineering department of Pickands Mather & Co., retired December 31. Butterworth joined the engineering department of Pickands Mather in 1925. In 1939 he succeeded the late W. H. Gallagher, Jr., then chief mechanical engineer.

Frederick S. McConnell, president, Enos Coal Mining Co., retired January 1. He was succeeded by George E. Enos who had held the office of executive vice-president.

One of the deans of the coal mining industry, McConnell was long active in the improvement of mechanical mining, helping the development of the largest strip mines in the world for the Enos organization in southern Indiana, where the company is a leading producer. He also served as chairman of the Enoco Collieries, Inc., an Enos subsidiary and operator of the largest deep mine in Indiana.

The following appointments have been announced by Miami Copper Co. and its wholly-owned subsidiary, Copper Cities Mining Co. John Gray has assumed the position of general superintendent of Miami Copper Co. and Copper Cities, a position formerly held by Jack Still. Maynard M. Stover is now mine superintendent of Copper Cities.

Gray has been with the Miami organization for 15 years in various engineering and operating capacities. For the 18 months prior to his promotion, he had been assigned to exploration activities of the company. Stover joined the organization in 1952 and advanced through engineering and operating positions to the post of acting mine superintendent in the absence of Gray on exploration work.

Francis B. Speaker has been appointed consultant on mining matters in the Office of Minerals Mobilization. Speaker was chief of the Non-Ferrous Metals Division of the War Production Board during World War II and he was director of the Mining Division of the Defense Materials Agency during the Korean War. At the present time he is employed in an engineering capacity by Hewitt-Robins Incorporated.

Two New Jersey Zinc Co. promotions have recently been announced, one in the main office and one in the operating department.

Robert A. Oberfell has been appointed an assistant secretary. Oberfell, an attorney, started his employment with New Jersey Zinc in the legal department in 1947. He was transferred to the secretary's department in 1953.

Howard W. Miller was named superintendent of the zinc mining operations for the company at Jefferson City, Tenn. Miller joined New Jersey Zinc in 1946 as a geologist attached to the exploration unit of the Austinville, Va., mine. He transferred to Jefferson City in 1949 and became assistant superintendent in mid-1955.

Harold L. Beattie has been appointed vice-president of operations of both the Elk River Coal and Lumber Co., at Widen, W. Va., and the Buffalo Creek and Gauley Railroad Co., at Dundon, W. Va. He will be in charge of coal operations at Widen, the lumber operations at Swandale, W. Va., and the railroad at Dundon.

Beattie joined the coal company as production engineer in 1951.

Raymond L. Walsh, assistant vicepresident and chief engineer of Universal Atlas Cement Co., retired December 31 after 30 years of service. He will be retained in a consulting capacity. Chester D. Rugen has been appointed assistant vice-president of engineering, and Robert B. Jordan was appointed chief engineer of the U. S. Steel Corp. subsidiary. Felix E. Wormser, Assistant Secretary of Mineral Resources, Department of the Interior, has been named

1956 recipient of the Egleston Medal, Columbia University's highest award for "distinguished and engineering achievement." The medal will be presented to Wormser on March 14 at a



dinner at the Waldorf-Astoria Hotel. At that time a specific citation of the award will be made public.

Peters Creek Coal Co. has announced the promotion of four employes.

Robert E. Kamm, superintendent of the Cornelia Mine for 3½ years, was named vice-president of operations. William S. Bryant, the first employe with the company, was elected vicepresident of finance and secretary. John Wright, who joined Peters Creek in 1949, was named superintendent of the Cornelia Mine. Percy Eads was named mine foreman at the Cornelia Mine.

#### - Obituaries -

Charles L. Albright, 68, retired vicepresident and secretary of the H. C. Frick Coke Co. & Associates, died in Pittsburgh, Pa., early in December. Mr. Albright began his career as a coal miner in 1905. He retired from active service in 1948.

Harold V. Trask, 40, chief metallurgist for the Cleveland-Cliffs Iron Co. for the past three years, died of a heart attack in Cleveland, Ohio, December 23.

Born in Johnston, N. D., Mr. Trask was a graduate of the University of North Dakota and the University of Utah. His first job was as mining engineer for the Mountain City Copper Co. of Utah. He worked for several other mining firms in the West before moving to Cleveland in 1950.

William J. Murphy, 60, vice-president in charge of sales and a director of American Potash & Chemical Corp., died of a heart attack December 11 at Glen Ridge, N. J.

Mr. Murphy began his business career in 1911 in New York with a predecessor company to American Potash & Chemical Corp. In 1919 he was transferred to the American Potash & Chemical Corp. main plant at Trona, Calif., later returning to New York in the company's sales department. He was named general sales manager in 1934 and vice-president in charge of sales in 1941 and was elected to the company's board of directors in 1947.



# Eastern and Central states

#### Harper Succeeds Campbell

H. John Harper, general manager of mines, Eastern Gas and Fuel Associates, has been elected vice-president in charge of Eastern's coal division mine operations. He succeeds L. C. Campbell, vice-president, who





H. J. Harper

L. C. Campbell

will assume responsibility for the firm's long range development of coal properties, serve as company representative in the Bituminous Coal Operators Association and handle special assignments for the president of the company. The change was effective January 1.

Harper has been with Eastern Gas and Fuel Associates' Coal Division and its predecessors since 1934. Joining the company as an engineer in the Pittsburgh office, he was soon transferred to take charge of the development of the company's Kopperston mine in West Virginia. He returned to Pittsburgh in 1939 as project engineer and two years later was promoted

to the position of assistant to the general manager of mines. He became assistant to the vice-president in 1944 and general manager of mines in 1951, the position he held until his election as vice-president.

L. C. Campbell is one of the nation's most prominent mining authorities. His background of 38 years of experience includes both metal and coal mining. He has been associated with coal operations of Eastern Gas and Fuel Associates and its predecessors for more than 25 years and has been in charge of the company's mining operations since 1941.

Campbell was recently reelected president of the National Coal Association. He has served on its board of directors for several years and has headed its Executive and Safety Committees. He is also chairman of the Coal Division of the American Mining Congress and has held many posts of responsibility in the National Safety Council.

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#### Titanium Mill

Crucible Steel Co. of America has announced plans for installation of a new \$2,500,000 mill for cold rolling stainless and titanium strip to thinner gauges than the company has previously produced. The mill, a 50-in. Sendzimir reversing cluster mill, will be the largest of its kind ever built for this purpose. It will be installed at Crucible's Midland, Pa., Works and will be in addition to already existing stainless and titanium cold rolling facilities. Installation is scheduled for completion in 1957, with a probable increase in work force at that time.

#### **Extend Barge Harbor**

Pittsburgh Consolidation Coal Co. has awarded a contract to Dravo Corp., Pittsburgh, for the construction of an extension to the firm's barge harbor on the Monongahela River at West Elizabeth, Pa.

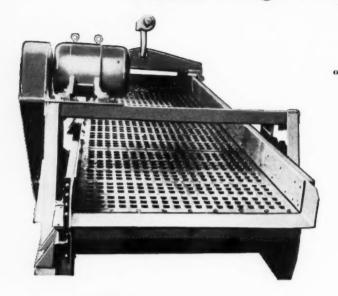
Four new cells of steel sheet piling, approximately 13½ ft in diameter and spaced 175 ft apart will be installed to provide additional facilities for mooring coal barges.

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600 ALL STEEL PIT CARS

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300 K. W. Westinghouse consisting of: Motor 432 H.P. Synchronous, 2200 volts; Generator 275 volts, D.C., 1090 Amps. Complete with starting equipment.

175 H.P., 2400/4000 volts, 1150 R.P.M. motor and magnelic controller. Jeffrey Air Operated Jig consisting of Standard Two-

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gine through magnetic clutch.

Compartment Five-Cell Baum Type Jig with 84" wide 200 K.W. Westinghouse, consisting of: Motor 290 H.P., Screen Compartment to handle 500 tons per hour.

Jeffrey No. 8-H-48 Aerodyne Fan with V-Belt drive and

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Jeffrey No. 8-H-60 Aerodyne Fan with V-Belt drive and

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#### **Promotions Announced**

J. D. A. Morrow, president since 1940 of Joy Manufacturing Co., Pittsburgh, Pa., has been elected chairman of the board by the company's board of directors. The directors also advanced John Lawrence from executive



J. D. A. Morrow



John Lawrence



W. L. Wearly



H. C. Nyquist

vice-president to president and chief executive officer, W. L. Wearly to executive vice-president, and H. C. Nyquist to vice-president of general sales.

During Morrow's tenure as company president, Joy's annual sales increased from \$5,000,000 to \$92,000,000 annually and net worth from \$2,900,000 to \$50,000,0000.

Lawrence, a graduate of Massachusetts Institute of Technology, joined the Joy organization in 1951 as vice-president, manufacturing. For the past year and a half he has been executive vice-president.

Wearly has been employed by the company since he graduated from Purdue University in 1937, working in production, engineering and service capacities.

Nyquist, graduate of Pennsylvania State University, came to Joy in 1946 from Tennessee Coal, Iron & Railroad Co., and has been vice-president of coal machinery sales.

#### **World's Largest Sintering Plants**

Koppers Co., Inc., has been awarded contracts by National Steel Corp. to build two sintering plants—each to be equipped with a sinter machine exceeding the size of any single iron ore sintering unit used in the world today. The plants will be erected for Weirton Steel Corp. at Weirton, W. Va., and for Great Lakes Steel Corp. at Zug Island, Mich.

Sintering facilities for Great Lakes Steel will include a sinter machine

with a 12-ft wide ore bed and an effective length of 199 ft, six in. It is expected that this huge unit will be capable of producing more than 7000 net tons of sinter per day. The material handling system will be constructed between three ore storage yards and the sintering plants and will include facilities for ore screening and crushing, and a storage system. Approximately 70 conveyors will be used.

At Weirton, Koppers will build a sintering plant equipped with a sinter

machine 12 ft wide with an effective length of 168 ft which is expected to produce approximately 6000 net tons of sinter per day. It will be the second sinter machine at the Weirton plant. Presently beginning operation is an 8-ft by 104-ft sinter machine capable of producing approximately 2500 net tons of sinter per day.

The two sintering plants are part of National Steel's \$200,000,000 expansion program recently announced by Ernest T. Weir, chairman.



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\*Strip Miner Drills 8-1/2" Blast Holes 60 Ft. Deep in 1 Hour, Including Moving Time.

Savings, like costs, are measured by the foot, especially in tough earth and rock formations. Using the new McCarthy 106-24 Vertical Drill, this Pennsylvania strip miner cut drilling time to 1 hr.-per hole (including moving time) on 60-ft. blast holes 81/2" in diameter. Formation was 20 ft. of soft top strata, 35 ft. sandstone and 5 ft. of hard sandstone and bastard limestone.

A new speed reducer on Model 106-24 slows auger rotation for drilling harder rock formations. The result is more torque, or "biting power." You have fewer bit failures, cutting over-all drilling time. Driller above used tungsten carbide bits.

above used tungsten carbide bits, The McCarthy Model 106-24—"World's Fastest Heavy-Duty Vertical Auger Drill" handles augers from 3" to 24" in diameter.

Write for Bulletin M-100



#### \$80,000,000 Aluminum Plant

One of aluminum's "big three," Reynolds Metals Co., has contracted to deliver more than 640,000,000 lb of aluminum to the Ford Motor Co. during the next ten years. Reynolds will deliver most of the aluminum in molten form direct from a new aluminum-producing plant to a Ford foundry to be built adjacent to it. The new aluminum plant will be built at Listerhill, Ala., at a cost of between \$75,000,000 and \$80,000,000. Construction will start immediately.

The new unit will be Reynolds' seventh aluminum-producing plant and will add 200 million lb to the company's annual capacity, bringing the firm's total capacity to more than 1.1 billion lb a year. Ford will take less than a third of the additional output, the balance being available for other fabrication.

Power for the new plant will be supplied by the Tennessee Valley Authority under a ten-year contract, with provisions for renewal, which calls for up to 225,000 kw a year.

#### **Cement Company Name Change**

The Ozark Portland Cement Co., of Tulsa, Okla., was referred to in the December issue of MCJ as Hercules Cement Co., Inc. According to Dun & Bradstreet, Inc., this company amended its charter on November 22, 1955, to provide for this change in name. Right to the use of the name Hercules is held by the Hercules Cement Corp., of Philadelphia, Pa.

While the Ozark Portland Cement Co. has just recently been formed and is in the planning stage of plant construction and quarry development, the Hercules Cement Corp. has been a substantial producer for 40 years.

#### **Coal Properties Sold**

The Philadelphia County Court has approved the sale for \$200 of 700 acres of anthracite coal properties near Girardville, Pa. The seller was Philadelphia's Board of City Trusts, trustee of the Estate of Stephen Girard, 19th century merchant whose will, in 1831, financed the building and operation of Girard College in Philadelphia for the benefit of "poor, white, male orphans."

The Girardville coal lands represented most of what was until 1954 the Hammond Colliery. In over 90 years of anthracite mining, these properties produced more than 21,000,000 tons of anthracite and paid some \$10,000,000 of royalties to the Girard Estate. Hammond Coal Co. operated the colliery from 1939 until April 1954 when it went into bankruptcy.

Only 16.5 acres of the Hammond Colliery's surface area was sold. Another 685 acres consisted of underground rights to coal—the bulk of the colliery's underground reserves—with surface rights retained by the estate.

Real estate taxes in 1954 on the portion sold were about \$22,000, and from April 1954, when Hammond ceased maintaining the mines, until January 1955, when the colliery's underground machinery was stripped out and the coal breaker demolished, the Estate spent about \$15,000 a month pumping water out of the pits and otherwise maintaining the mine. Protection of the property and equipment cost another \$800 a month.

Once the coal pits were abandoned to flooding and the colliery's machinery and equipment sold to salvage, the Hammond Colliery as a deep-mine anthracite producer was finished.

It has been estimated that it would cost at least \$1,000,000 to rehabilitate the underground mines and restore the colliery to operation.

#### **New Cleaning Plant**

Pocahontas Fuel Co., Pocahontas, Va., has entered into a contract with Daniels Co., Contractors, Inc., Indiana, Fa., for a complete new preparation plant for its Jenkinjones No. 7 mine in McDowell County. The contract calls for installation of a dense media separation system for preparing eightin. by ½-in. run-of-mine coal from the Pocahontas No. 3 seam.



#### Oliver I. E. Departments

Establishment of industrial engineering departments in its operating district headquarters at Virginia, Hibbing and Coleraine was announced by the Oliver Iron Mining Division of United States Steel.

J. E. Machamer, vice-president of operations, under whom the new departments will function, said the newly created organization will assist in the development of new and improved

methods of production,

The men designated as industrial engineers have been specially selected from Oliver's district operating staffs to take charge of the new activity in their respective areas. They include Gordon R. Wynne, formerly assistant superintendent of Extaca, John B. Pardon, locomotive shop maintenance foreman, Emmett M. Gilmore, operating engineer, Russell A. Oxendale, maintenance engineer, and Louis Scipioni, general pit foreman.

#### **Plant Expansion Slated**

International Minerals & Chemical Corp., Chicago, will double the production capacity of its Bonnie plant near Bartow, Fla. When this expansion program is completed the Bonnie plant, major unit of the corporation's Phosphate Chemicals Division, will be able to produce 500,000 tons of triple superphosphate and feed-grade dicalcium phosphate annually.

International has earmarked \$4,000,000 for the first step in this program, which is to include a second sulfuric acid plant and new equipment for the neutralization and recovery of plant effluents.

#### **Rescue Station Built**

A new mine rescue station has been constructed by Semet-Solvay Division, Allied Chemical & Dye Corp., at its Tralee mine in Wyoming County, W. Va.

The 40 by 28-ft steel building contains two rooms, one of which will be used for a lecture room and for safety meetings. The other is used for minerescue and first-aid training.

#### Canadian Iron Mine to Open

Pickands Mather & Co. of Cleveland and the Steel Co. of Canada are reopening, at the cost of \$16,000,000, an iron ore mine in Canada which had been in operation for 85 years.

The project involves construction of a \$12,000,000 iron-ore processing plant and the construction of a three-mile railway to link the property with the Canadian Pacific Railway. The new plant and the mine, located at Bristol, about 40 miles northwest of Hull, Quebec, would provide work for about 300 persons when it goes into operation late next year.

The two firms will split the cost

of the development and share in the anticipated 600,000-ton-per-year production. Half of the processed ore will stay in Canada and the other half will be shipped to Pickands Mather customers in the United States.

It is estimated that the iron ore reserves are sufficient to sustain a 600,000-ton annual production for the next 15 to 20 years. The operating company, to be known as Bristol Quebec Mining Co., Ltd., will be wholly owned by Pickands Mather in conjunction with the Jones & Laughlin Steel Corp., Pittsburgh.

#### Uranium in S.W. Sweden

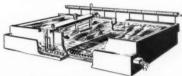
Sweden's state geologist, Dr. Joseph Eklund, reported that a rich uranium deposit has been found under the Bilingen Mountain, in the Vaestergoetland Province of Southwest Sweden. The ore is contained in a shale strata and the grade is higher than the uranium content of the slag heaps of the South African gold mines—another big uranium source—but below United States deposits in Colorado.



CONICAL SCRUBBERS



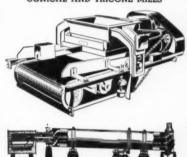
CONICAL AND TRICONE MILLS



AUTOMATIC BACKWASH SAND



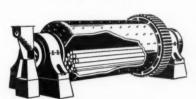
"AUTO-RAISE" THICKENERS



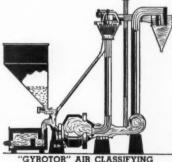
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RUGGLES-COLES DRYERS



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CONVEX HEAD ROD MILLS



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Write for Bulletin 100-A-52 describing the entire line

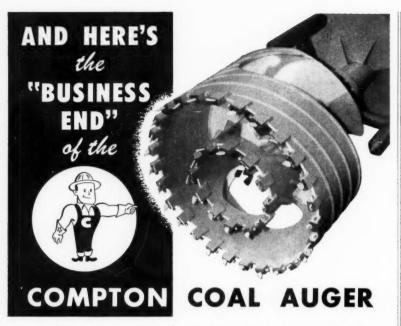
### HARDINGE COMPANY, INCORPORATED

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Main Office and Works

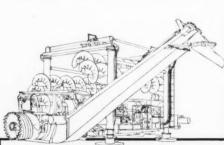
New York • Toronto • Chicago • Hibbing • Houston • Salt Lake City • San Francisco



Just stop for a moment and study this photo of the Compton patented Lump Recovery Head . . . it certainly looks formidable even in print!

This non-clogging head was developed by Compton for exclusive use on the Compton Coal Auger. Driven by a power-packed diesel engine, the Compton Auger Head, with its top efficient core breaker, is a wonderful sight to behold as its 32 carbide tipped cutting bits cut and auger their way into the seam of coal in a jiffy.

A built-in spider bearing assembly provides "compass-straight" drilling with very little frictional drag. Engineered to cut coal at high speed, the Compton Lump Recovery Head will not clog and turns out a steady stream of coal from head to truck. Head diameters vary, depending on the size auger, from 44" to 28". The peripheral speeds maintained for all diameters makes it possible to get large tonnages even with the smaller diameter augers.



A Compton Coal Auger plus the Compton Lump Recovery Head will contribute to the efficiency of your operation. Call a Compton sales representative today . . . he is qualified to advise you on the possibilities which exist on your property for profitable Compton Auger Mining.

COMPTON, INC.
ORIGINATORS OF COMPTON LUMP RECOVERY HEADS

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#### Two Accident-Free Years

The Duluth plant of the Universal Atlas Cement Co. completed two calendar years of work without a single lost-time accident on January 1, according to an announcement by Roald W. Nygaard, manager of the U. S. Steel subsidiary operation.

"Last year was the thirteenth accident-free year in the plant's history," Nygaard said. "This achievement in safety could not have been accomplished without the full cooperation of every man in the plant." The 325 men employed there worked a total of 650,000 man-hours during 1955 without incurring a disabling injury.

The plant will be presented with a safety award by the Portland Cement Association at ceremonies to be held in Duluth this summer.

#### Louise Mine Reopened

Trotter Coal Co., Morgantown, W. Va., has reopened its Louise Mine in Monangehela County, W. Va. Rehabilitation of the mine, which was closed in 1952, began in January.

The mine formerly produced about 1000 tons of Sewickly seam coal daily, and employed about 125 men.

#### **Uranium Refining Contracts**

The Atomic Energy Commission signed a new four-year contract with Mallinckrodt Chemical Works for operation of two AEC plants in the St. Louis, Mo., area for refining ores and concentrates into uranium metal.

Under the new contract, AEC will pay Mallinckrodt on a cost-plus-fixed-fee basis. The Commission's previous contract with Mallinckrodt provided for production at a unit price and placed research, development and minor construction on a cost-reimbursement basis. Under the new setup, the Government will furnish working capital for the operation and will pay a fixed annual fee.

#### FOR SALE—USED EQUIPMENT

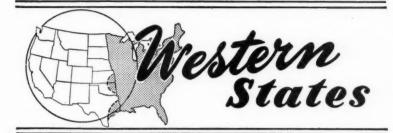
Subject to Prior Sale or Commitment

- 1—375-B Bucyrus-Erie Dragline, Serial No. 10714, equipped with 155-ft. boom, 10-yd. bucket.
- 1—360-M Marion Dragline, Ser. No. 5700, equipped with 150-ft. boom, 10-yd. bucket.
- 1—Set Dragline Equipment for Marion Model 4101, as follows: 90-ft. boom; Fairlead; Drag Drum, complete with gears, pinion, clutch band, brake band and lagging for hoist drum (bucket not included).

For further information, contact: Purchasing Agent

#### TRUAX-TRAER COAL COMPANY

111 North Wabash Avenue Chicago 2, Illinois



#### **Utah Mining Association**

At the annual meeting of the Utah Mining Association held December 12, the following officers were elected: president, L. F. Pett, general manager Utah Copper Division, Kennecott Copper Corp.; first vice-president, Clark L. Wilson, vice-president, New Park Mining Co.; second vice-president, Charles A. Steen, president, Utex Exploration Co., Inc.; and vice-president and consultant, A. G. Mackenzie. Miles P. Romney was reelected secretary-manager and Walter M. Horne, assistant secretary-manager.

#### **Anaconda Acquires Mines**

Anaconda Co. has signed 10-year options to purchase two mines in Arizona, according to Hugh T. Cuthbert, secretary-treasurer of the Bellemont and Queen Creek claims. Cuthbert said that agreement is expected shortly on two other properties, the Grand Pacific and the Magma-Superior. The four properties are contiguous and are located near the Magma Copper Co., south of Superior, Ariz.

#### **Calaveras Expansion**

Calaveras Cement Co. has advanced by several months the completion date of its \$4,000,000 plant expansion program which originally was scheduled for the end of 1956, President William Wallace Mein, Jr., has announced.

Major item in the expansion program is a 360-ft rotary kiln which is in the final stages of fabrication in the San Francisco shipyards of Bethlehem Pacific Coast Steel Corp. It is Calaveras' fifth, and will raise the company's production capacity by 30 percent to more than 4,500,000 bbl of cement per year.

On January 11 the first of eight 45-ft sections of the kiln already had arrived at the Calaveras plant in San Andreas, Calif. The other sections were to continue moving by rail at three-day intervals until the shipment was complete. Supporting piers for the kiln already were in place, and the sections were to be assembled into a completed unit without delay. Diameter of the kiln is 11 ft 3 in.

Calaveras already has completed the construction of new cement storage silos and new slurry tanks which are a part of the over-all expansion program. Other installations will include new coolers, electric precipitator, multiclone, thickener, raw and finish mills, auxiliary buildings, and materials handling equipment.

#### Copper in Water

Union Copper Co., subsidiary of Daybreak Uranium, Inc., plans to recover copper from water pumped from five old copper mines at Copperopolis, Calif., 23 miles east of Stockton, according to James F. Fox, president of Daybreak.

The company has installed a special pump and expects to start pumping and leaching operations immediately. It expects to recover a 43 percent copper concentrate by running the water over beds of tin cans from which the tin has been burned off. An old plant, built in the 1920's will be used in the leaching operation.

The mines at Copperopolis contain 30 miles of tunnels and raises and have not been pumped out since 1930, Fox said.

#### Metal Mining and Industrial Minerals Convention In Los Angeles

W. C. LAWSON, general manager, Phelps Dodge Corp., Douglas, Ariz., has accepted the chairmanship of the Program Committee for the 1956 Metal Mining and Industrial Minerals Convention and Exposition of the American Mining Congress, which is to be held at the Shrine Auditorium, Los Angeles, October 1-4. A committee of leading mining men, representing all producing areas of the country, will work with Lawson in the development of a program for the meeting that will feature an interchange of views between representatives of the industry, top Government officials, and members of Congress, on Federal policies affecting mining.

The discussions of mineral policy questions will share the spotlight with consideration of the latest developments in operating methods and equipment in all phases of metal and industrial mineral production and treatment

Garner A. Beckett, president, Riverside Cement Co., Los Angeles, who is chairman of the Western Division of the American Mining Congress, is taking an active part in developing plans for the meeting. Trips to nearby mining and industrial operations are being scheduled for the mining visitors, and arrangements are being made so that convention delegates will be able to visit Walt Disney's famed Disneyland.

In addition to the convention sessions, the AMC Manufacturers Division, under the chairmanship of Guy V. Woody, Allis-Chalmers Mfg. Co., will sponsor the greatest exhibit of mining and mineral processing equip-



W. C. Lawson

ment and machinery ever held in this field. Every type of modern equipment used to produce metals and minerals today will be shown by more than 150 mining manufacturers. As of now, 20 percent more exhibit space is under contract than was used at the largest previous Mining Show, held in San Francisco two years ago.

The Housing Committee has again arranged to have reservation blanks distributed by mail and to set up a Housing Bureau in Los Angeles to handle the applications. Prompt submission of these applications is important because the bureau will start processing in March. Anyone who does not receive a blank should request accommodations directly, addressing AMC Housing Bureau, % Los Angeles Chamber of Commerce, 1151 South Broadway, Los Angeles 15, Calif.

#### Lucky Mc Uranium Mill

Lucky Mc Uranium Corp. and the Utah Construction Co. are preparing to enter into formal negotiations with the Atomic Energy Commission for construction of a uranium mill, according to W. H. H. Cranmer, Lucky Mc president, Salt Lake City, Utah.

"We feel that we can at least commence negotiations on other facets of a mill contract, including metallurgy. By the time we clear these questions up, we will know better what the actual reserve picture is and then we can state the size of mill we wish to build," Cranmer said.

In the meantime, Utah Construction will continue its drilling program at the Gas Hills, Wyo., property. The estimates now current are that Lucky Mc has in excess of 1,000,000 tons of proved ore in the district.

#### Spokane Uraninite

The primary uranium mineral uraninite has been identified as the radioactive mineral in two recent discoveries in the Spokane Indian Reservation, according to officials of Daybreak Uranium, Inc. and of Big Smoke Uranium, Inc., and confirmed by the Spokane office of the Atomic Energy Commission.

D. L. Hetland, geologist in charge

of the AEC's northwest district office in Spokane said the samples identified as uraninite were forwarded by him to Salt Lake City and were tested at the Bureau of Mines' Intermountain experiment station.

One of the Big Smoke samples was identified as thucholite, a hydrocarbon of uranium and thorium.

#### Stauffer Phosphate Deposit

After nearly five years of exploration and development work, Stauffer Chemical Co. has established the existence of large minable deposits of high grade phosphate rock on its patents near Bear Lake, Idaho. Reserves in the deposits are estimated at over 5,000,000 tons of commercial grade phosphate rock and may, according to Stauffer, be doubled or even tripled if the beneficiation of lower grade secondary beds proves feasible.

Development work is being carried out for Stauffer by San Francisco Chemical Co. in collaboration with Stauffer's geologists. The work includes a 1400-ft adit extending at mining depth to the main phosphoria bed, a 3000-ft drift along the main bed, and a 1500-ft raise from the adit and drift to surface elevation above the deposit. The adit has been completed and the entire development project should be finished by the end of the year. Total



cost of the project is estimated at \$400,000.

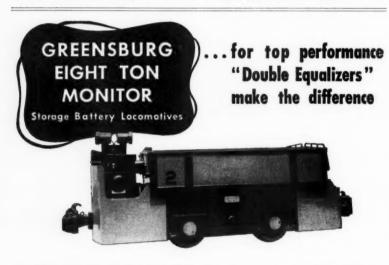
The Bear Lake deposit will provide a long-term reserve for the requirements of Stauffer's west coast phosphate fertilizer plants at Richmond, Calif., Vernon, Calif., and Tacoma, Wash., as well as for the Garfield, Utah, plant of Western Phosphates, Inc., an associated company of Stauffer.

#### **Uranium Buying Stations**

One new uranium ore-buying station will be opened by the Atomic Energy Commission in the near future and one has just been opened. A station at Tuba City, Ariz., was opened February 1 and one at Grants, N. M., is scheduled for operation on about April 1.

The Tuba City station includes the sampling plant which was constructed and is owned by Rare Metals Corp. of America and is now leased to the Commission, pending the completion of the uranium processing mill being erected on the same site by Rare Metals. After completion of the mill, scheduled for the spring of 1956, Rare Metals will take over the sampling plant to purchase ores for their own account. In the meantime, the Tuba City sampling plant will be operated for the Commission by its ore-buying agent for the purchase of ores that are amenable to the treatment processes being provided. Those uranium ore producers that desire to sell their ore at Tuba City, which is located about 75 miles north of Flagstaff, are advised to deliver trial shipment of their ores to the sampling station. This trial lot will be mechanically sampled and a portion of the lot will be subjected to tests to determine if the ore is amenable to the Tuba City mill process.

The Grants ore-buying station will be of the semi-portable type and will be located about three miles northwest of Grants. The station will serve the area pending construction of new milling facilities. Because of the limited capacity of the temporary ore-buying station, it may be necessary to limit the deliveries from individual producers in order that as many producers as possible will have an opportunity to sell ore. In order to plan and schedule deliveries, the Commission will require advance information on ore reserves, the development status of the property and planned rate of production.



The Greensburg 8 ton Monitor is equipped with two glass insulated motors, contactor type controller and double equalizers. These double equalizers make the difference in performance . . . more tractive effort, better brakes, better riding qualities and longer battery life than any other storage battery locomotive of equal weight and battery capacity!

All Greensburg locomotives are Custom-Built to meet your requirements in both single and double motor drive with drum, cam or contactor type controllers.

For more earning power per invested dollar specify Greensburg Storage Battery Locomotives.

GREENSBURG MACHINE CO.

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#### INDUSTRIAL HOSE AND FITTINGS

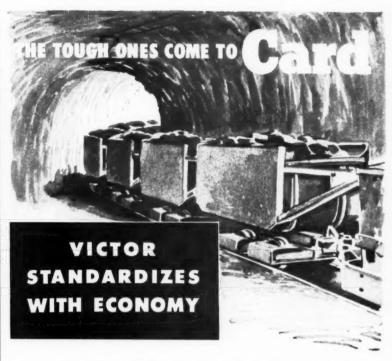
Super resistance to abrasion and corrosion makes this hose excellent for railroads, road equipment, farm machinery, and materials handling equipment. High tensile strength single wire braid. Tough synthetic rubber cover. Working pressures to 2500 psi. Bulk hose and fittings . . . complete hose assemblies at your dealer.



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The Maiden Rock Mine of Victor Chemical Works first started using Card cars in 1950. Chosen design was a Granby type car of 57 cu. ft. capacity built on 24" gauge and featuring coil spring suspension. The phosphate rock being handled is relatively clean to handle, and the car design is unusually well suited. As a result, not a single Card car has ever had any significant repairs although some wheels have been replaced. Fifty-two of these cars are now in service, representing several re-orders over a four-year period.

Much of the haulage at Maiden Rock is underground, and many of these Card cars seldom see the light of day. The steady day in, day out service record of the cars has meant high production with remarkable economy for Victor—one of the three largest producers of elemental phosphorus.

Standardize your haulage with an economical Card design. Our engineers can furnish an efficient car to meet your most difficult specifications.



C.S. Card Fron Works Co.

DENVER COLORADO

#### **Rock Mechanics Symposium**

On April 23-25 the Colorado School of Mines is sponsoring a Symposium on Rock Mechanics at Golden, Colo. The conference is intended to attract participants from the fields of mining, civil, and military engineering, geophysics, and structural geology.

The entire field of rock failure and its controls, including drilling, blasting, design and support of underground openings, and caving methods of mining, will be included in the discussions at Golden.

Keynote speaker will be C. W. Livingston, former head of the Mining Department of the Colorado School of Mines and now a senior consultant to the Department of the

The school has invited advance registration for the event-the fee is \$5.00.

#### Arizona Access Roads

The U.S. Bureau of Public Roads will construct two access roads in the Sierra Ancha district, north of Globe, Ariz., to assist in the development of uranium properties in that area. Funds for the projects have been made available by the Atomic Energy Commission, and the Gila County Board of Supervisors has agreed to maintain the roads after they are built.

The access roads are located north of Globe in the Cherry Creek area and in the Bull Canyon-Deep Creek area. The Cherry Creek road will begin at the Ellison ranch, and extend north 18 miles to connect with the Globe-Young highway about 10 miles south of Young. The Bull Canyon-Deep Creek road begins at a point on the Cherry Creek road about 10.5 miles northeast of the Globe-Young highway and extends north 6.5 miles. According to B. M. French, BTR district engineer, bids ranged from a low of \$108,302 to a high of \$159,924. The roads will be about 12 ft wide and will be built with bulldozer and then

#### Prospects in Utah

Sunshine Mining Co. is beginning to explore for metals in Utah because "we think Utah is good hunting territory," says Robert M. Hardy, Jr., executive vice-president of the Coeur d'Alene, Idaho, district concern. No specific metallic or non-metallic mineral has been pinpointed as an objective, but from time to time we will have a field representative working the Utah country, Hardy said.

Spokane Drilling Program

Dawn Uranium & Oil Co. has announced the completion of a 19-hole drilling program which indicated uranium ore of commercial value on its new properties in the Mount Spokane district, according to Charles B. Wieber, vice-president. The ore body lies at depths of from 15 to 50 ft.

The wagon drill holes were probed under the supervision of geologists with the Atomic Energy Commission. Wieber said the company is applying to the Defense Minerals Exploration Administration for a loan to help finance deeper drilling.

#### **British Columbia Output**

The mineral production in British Columbia during 1955 was estimated at \$174,500,000 by Mines Minister Robert Sommers. This was well over the 1954 figure of \$153,377,315 and just under the 1951 record of \$175,-600,000. The province's output of zinc was up materially last year from 1954, while production of gold, silver, copper and lead decreased moderately.

#### Deeper Work at Hercules

Development plans for the Hercules mine north of Burke, Idaho, include sinking a vertical winze to the 1900 level in the west end of the mine for deeper exploration of the Rambler vine and ore body, according to Garth Crosby, senior geologist, Day Mines, Inc. He did not disclose when the deeper development is expected to get under way. The mine has been closed as a result of labor difficulties since August 24, 1955.

#### Acquire All of Chemical Plant

Completion of the acquisition of 100 percent of the stock of Western Electrochemical Co., Henderson, Nev., by American Potash & Chemical Corp. through exchange of shares was announced December 23 by Peter Colefax. American Potash & Chemical, which had owned 48.2 percent of Western Electrochemical's common stock, issued 33,295 shares of its Class B stock to acquire the balance.

Colefax also announced that the name of Western Electrochemical Co. has been changed to American Potash & Chemical Corp. (Nevada) in order to facilitate the integration of the new company's activities into those of the parent organization, and that the Nevada company's products will be sold under the "Trona" brand name through the sales organization of American Potash & Chemical Corp.

The products manufactured by American Potash & Chemical Corp. (Nevada) at its plant in Henderson include ammonium and potassium perchlorate, sodium and potassium chlorate and manganese dioxide.



#### **Texas Uranium**

Rare Metals Corp. of America, affiliate of El Paso Natural Gas Co., continues to encounter mineralization but has as yet found no commercial uranium ore body in drilling in Karnes County, Tex., according to M. H. Kline, Salt Lake City, vice-president and assistant general manager.

Other companies active in the same area include Climax Uranium Corp., subsidiary of Climax Molybdenum Corp., and Continental Oil Co.

#### Copper Discovery

Atlas Uranium Corp. has reported a discovery of a sizable copper deposit in the Lisbon Valley, southeast of Moab, Utah. President J. C. Burgess said that flowsheet studies already are under way to determine the most economical recovery process.

The copper strike was made last August, and after further drilling and assays revealed a substantial ore body, the Colorado School of Mines Research Foundation was asked to make studies of recovery methods. Burgess said that strip mining of the ore body will be possible.

#### **Natural Gas Pipeline**

Officials of the Westcoast Transmission Co. have reported they will be able to complete their pipeline by early 1957 as a result of a ruling by the United States Federal Power Commission authorizing the import of Canadian natural gas. The FPC ruling permits the piping of Canadian gas into the northwestern United States and allows the Pacific Northwest Fipeline Corp. to import 300,000,000 cu ft per day from Westcoast.

Pacific Northwest had said earlier that as soon as permission was granted they would spend more than \$28,000,000 for new facilities, including 955 miles of new pipeline, to handle the Canadian gas.

Westcoast's pipeline, running through British Columbia, was to cost \$150,000,000 and will be the first major natural gas line in Canada.

Pacific Northwest estimates that they would spend a total of \$246,000,000 in facilities, including their pipeline from the San Juan Basin in New Mexico and Colorado. This line runs along the eastern boundary of Utah and is already well under construction.

The FPC also issued a permit to the El Paso Natural Gas Co. to build an additional pipeline to provide more gas for customers in California, Nevada, Arizona, New Mexico and Texas. The additional pipeline will cost an estimated \$194,274,000. Also granted was an application by the Nevada Natural Gas Pipeline Co. of Las Vegas to build new facilities costing \$4,103,188 to enable this company to receive additional gas.

#### BEE-ZEE SCREENS

lower moisture raise BTU's halt freeze-ups speed sales When Bee-Zee Screens put their efficiently-shaped rods to work "squeezing" that extra percentage of water out of your coal – it makes you money! Moisture content is lowered... your customers get more BTU's per ton... winter freeze-ups are avoided... and all of these advantages are reflected on your sales chart.

Bee-Zee Screens are made in the exact size and shape for your equipment—with the exact rod design for your operation. They're 100% stainless steel, electronically precision-welded. Bee-Zee Screens can't rust, can't corrode—and reduce "down time" by wearing longer.



#### **New Mexico Copper**

The Henry Clay mine in Hidalgo County, N. M., is being reopened according to the Office of the State Inspector of Mines. The copper property was first operated in 1878 and was shut down in 1929 due to low copper prices. It is now being readied for production by Brannon and Fuller of Silver City.

#### North Dakota Coal Output

George B. Easton, North Dakota mine inspector, has reported that 2,-975,725 tons of coal were produced in North Dakota lignite mines during the fiscal year ending June 30, 1955. This production resulted in an increase of 173,251 tons over production during the preceding 12-month period.

#### **Calera Cobalt Refinery**

Calera Mining Co., subsidiary of Howe Sound Co., which is mining cobalt and copper from its Blackbird mine near Cobalt, Idaho, has resumed operation of its cobalt refinery at Garfield, Utah.

Chemical Construction Co., which built the refinery in 1953, took over management of the installation in February 1954 after operational difficulties had developed. Problems in connection with utilization of a new chemical process have been overcome and Calera has again taken charge of the operation.

#### Colorado Mill Expansion

Trace Elements Corp., which signed a contract with the Atomic Energy Commission last August to construct a uranium mill at Maybell, Colo., has submitted a new proposal to the Commission, asking for a substantially larger capacity for the proposed installation. Firm officials, in announcing the proposal, said they have asked for a contract allowing the mill to process several times the amount of ore agreed upon with the AEC last

Information for the new mill was gained from the operation of a pilot plant at Maybell. The facilities will be the first uranium processing plant in the northwestern-Colorado and southwestern-Wyoming area and is scheduled to handle ore from properties owned and controlled by Trace Elements, as well as from other producers in the area.

#### Scholarship Award

The Gardner-Denver Scholarship at Montana School of Mines, valued at \$600 per year has been awarded to Robert Dorman, a junior student in mining engineering, President J. R. Van Felt has announced.

Presented to the School of Mines by the Gardner-Denver Co., manufactur-ers of mining equipment, this scholarship is open to juniors and seniors majoring in mining engineering. Vicepresident B. P. Spann of Gardner-Denver, in presenting this award to the school, stressed the nation-wide shortage of mining engineers and the great opportunities open to them.

#### **New Park Discovery**

New Park Mining Co. has confirmed the discovery of an increase in values of gold, silver and copper in a branch of the Pearl fissure at its Park City District mine in Utah.

W. H. H. Cranmer, president, said the main importance of the discovery was not in the values of metals, but in the fact that a traditional leadsilver-zinc camp was capable of producing ore of high-grade gold and

copper.

The discovery of the ore, was made on the 1755 level, about 500 ft east from the main shaft now being deepened. Two raises have been made in mining this ore and three other raises are being completed. The ore extends up and down the entire height of the drift and averages from two to two and a half ft in width on the 1755 level. Mine crews are now starting to drive east on the 1880 level and are expected to reach a point of junction on the high-grade below the discovery of the 1755 level in approximately three months.

#### Midnite Ore Body

Ore bodies at the Midnite uranium mine in the Spokane Indian Reservation range up to several hundred feet in length, 30 ft or more in thickness and at explored depths up to 250 ft below the outcrop, according to Robert J. Hundhausen, manager of the Dawn Mining Co., subsidiary of Newmont Mining Corp.

"Uranium minerals include autunite, uranophane, torbenite, gummite and an unidentified uranium silicate," Hundhausen said. "Pitchblende has been tentatively identified in drill cores. Hyalite, a green fluorescent mineral of opaline quartz, may contain a minor amount of uranium. A minor amount of monazite has been identified in the granite." He said drilling and underground work has "outlined sufficient ore reserves to consider building a uranium mill in this area if other deposits are found." He confirmed a previous report that milling tests of the ore are being made.





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#### Calera Takes Over Refinery

Calera Mining Co. and Chemical Construction Co. have announced that after more than a year of experimentation at the Garfield, Utah, plant of Calera, cobalt is being taken successfully from cobalt-copper ores. A refinery, built by Chemical Construction, a division of American Cyanamid Co., will be operated by Calera, a subsidiary of Howe Sound Co., The cobalt-copper ore is mined at Calera's Blackbird Mine at Cobalt, Idaho, and concentrates are treated in a high pressure, high temperature reduction system using a new chemical process to separate the cobalt from other minerals in the concentrates.

#### **Oregon Chromite**

Comstock Uranium & Tungsten Co. of Salt Lake City has made a substantial discovery of chromite ore at John Day, Ore., according to C. G. Cafarelli, president. The discovery was made at the end of a 300-ft tunnel. Shipments of high-grade ore were to begin in January to the Grants Pass, Ore., buying station, while lower grade ores will be treated in a renovated 100-ton per day mill on the properties.

#### **Silver Summit Development**

Polaris Mining Co. has reported the discovery of "fair grade mineralization" in diamond drill holes on the new 2500 level of its Silver Summit mine in the silver belt southwest of Osburn, Idaho. The importance of the new find cannot be appraised accurately until it has been opened by crosscut and drift work now under way.

Ore was found from 100 ft to 150 ft south of the main 2500 level drift which has followed the footwall of the Silver Summit vein system westerly to within 450 ft of the New Purim area.

Additional exploration work is also in progress on the Chester area on the 3000 level. A north crosscut has been driven from the exploration lateral to the vein in the area of the Chester west boundary where two drill holes intercepted good ore several months ago, and the mineralized area will be opened by drift in the near future. A south crosscut from the lateral is also being driven to provide a diamond drilling station from which down holes can be drilled to test the vein about 200 ft below the 3000 level.

Meanwhile, the 3000 level exploration drift into adjoining properties on the east has been advanced a total of 7800 ft since the beginning of the project, which is being done under a Defense Minerals Exploration contract. No important mineralized structures in this area have been exposed in recent months. The face is now about 480 ft west of the Rainbow west boundary. Contract terms provide that they be extended 1900 ft into Rainbow ground.

#### **Eureka Operation Resumed**

Production has resumed on the Prospect Mountain lead, silver and gold property of the Consolidated Eureka Mining Co. near Eureka, Nev., following a fire which destroyed the power house and other mine buildings. Operations were resumed when the Eureka Light & Power Co. extended a power line to the property.

About 10 tons of ore a day is being shipped to the Salt Lake City smelter of the firm.

#### San Manuel Production

San Manuel Cooper Corp., whollyowned subsidiary of Magma Copper Co., has started production of copper at its new low-grade copper ore body at San Manuel, Ariz., according to A. J. McNab, chairman. "Initial output will be comparatively small," Mc-Nab said, "but it is hoped that full production will be reached by San Manuel about the middle of this year."

#### **Lucky Friday Hoist**

Lucky Friday Silver-Lead Mines is completing a concrete foundation for a hoist at its new 2300-ft three-compartment shaft east of Mullan, Idaho, according to Dave Elder, superintendent. A 400-hp double-drum hoist has been purchased from American Smelting & Refining Co. and completely reconditioned. The hoist had been used in the Morning mine.

Production at Lucky Friday is continuing through the old shaft at from 100 to 110 tons of ore daily, he said, and a 3000-ton stockpile has been accumulated.

#### **Utah Mining Manual**

Miles P. Romney, manager, Utah Mining Association, has started distribution of a 115-page mining manual, "Utah's Mining Industry," which covers the history of metal and mineral mining in Utah. It breaks down on a county-by-county basis the known minerals and their mining status. Charts, maps, statistics on production and description of reduction of ores into metals, as well as a resume of economic problems of the industry are contained in the publication. Statistical material is current to December 31, 1954.

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#### **Geneva Steel Expansion**

United States Steel Corp. has programmed a multi-million dollar expansion of its steel production of its Columbia - Geneva division plant at Geneva, Utah. The plant will be completed during the next two years largely through enlargement of the 10 open hearth furnaces, now operating at about 260 ingot tons daily, to 300 tons daily. This would hike annual ingot output at Geneva from a

present 1,879,000 tons to about 2,260,-000 tons a year.

Roger M. Blough, chairman of the board, said the expansion program is based on the recognition by U. S. Steel that "future requirements of the country's growing economy clearly indicates a need for steel production." He also reported that ingot capacity in the Chicago area would be increased by approximately 1,500,000 tons annually through various improvements to facilities there.

consumer. They are being supported by consumer groups, municipal officials and a host of others who want the FPC to continue to have control over natural gas producers and gatherers. Majority Leader Lyndon Johnson (Dem., Texas) is spearheading the drive for enactment of the bill.

The coal industry is supporting amendments to the measure proposed by Senators Kilgore (Dem., W. Va.) and Watkins (Rep., Utah) which would require the FPC to give effect to sound principles of conservation in administration of the law, and bar the exportation or importation of natural gas in any case where the FPC finds that such exportation or importation will result in unemployment, or injury to competing fuel industries of the United States.

Proponents of the bill predict that they have enough votes to secure Senate approval, without amendments of a major nature. The leadership is trying to get the bill through the Senate in the same form as it passed the House in order to prevent a long hassle in a conference between the two Houses. The President has carefully avoided committing himself on the bill, stating that he will act on it after it reaches the White House. Most observers, however, freely predict that if the measure reaches the President's desk in its present form it will be signed.

#### Wheels of Government

(Continued from page 151)

crease residual oil imports because of a tight fuel oil supply situation due to the prolonged cold weather.

#### **Tariff Developments**

Prospects for Congressional approval of U. S. membership in the Organization for Trade Cooperation (OTC), to administer the controversial General Agreement on Tariffs and Trade (GATT), are very dim.

Strong opposition has developed in both political parties, from those wishing to protect American industry and labor from a heavy influx of products from abroad and from control of American trade by an international agency. Particularly in an election year, sentiment runs high in opposition to any legislation that will react unfavorably upon the American voter.

Chairman Cooper (Dem., Tenn.) of the House Ways and Means Committee has indicated that hearings on the OTC measure will have top priority. The American Mining Congress will register its opposition to the bill. The Mining Congress has consistently been opposed to U. S. participation in any organization which places the power to regulate trade and foreign commerce of the United States in the hands of any international body.

Meanwhile, on the tariff front, the U. S. Tariff Commission has submitted a report to the President setting forth its findings in the "escape clause" investigation with respect to acid grade fluorspar, which began last August. The Commission split three-to-three in its findings.

Commissioners Brossard, Talbot and Schreiber, all Republicans, found that acid grade fluorspar was being imported in such heavy quantities as to threaten serious injury to the domestic industry. They recommended that the trade agreement concession reducing the import duty from \$5.60 to \$2.10 per long ton be withdrawn, thus restoring the 1930 rate. Commissioners Sutton, Jones and Dowling, all Democrats, found that the domestic industry was not seriously threatened and therefore made no recommendation for modification or withdrawal of the existing tariff rate.

With this division in the Commission report, most observers feel that the President will not act to modify the existing duty.



The first major measure to be considered by the Senate in this session—proposed amendment of the Natural Gas Act to exempt producers and gatherers of natural gas from Federal Power Commission regulation—has become the subject of prolonged and acrimonius debate.

Strong opposition to the bill is being registered by several Senators who take the position that its passage will boost natural gas prices to the

#### Freight Rate Boost

Unless the Interstate Commerce Commission acts to modify or block an across-the board freight rate hike of seven percent sought by the nation's railroads, the new rates will become effective on February 25, subject to later action by the ICC.

Opponents of the proposed rate increases had until February 3 to file statements in opposition. Several representative coal industry organizations strongly opposed the new increases, charging that if the hike were granted it would take \$75 million per year from the industry. They asked the Commission to hold a separate hearing on the reasonableness of the increase as to coal, but this was denied by a panel of the ICC. They then sought to have this denial reversed.

It was pointed out that the freight rate on coal constitutes over 40 per cent of the delivered price, this being higher than is applicable to any other commodity. They said the railroads had not shown that there was any emergency demanding the imposition of the increase and that the Commission should not contemplate "roadside justice" in the determination of matters of this moment. At this writing the Commission has not ruled on this second coal industry request.





#### Gearmotors and Motogears

A completely new line of Gearmotors and Motogears, in keeping with new NEMA motor sizes, has just been introduced by Link-Belt Co.

Link - Belt Gearmotors and Motogears are rated in accordance with AGMA standards. The Gearmotors



range up to 30 hp, and the Motogears up to 60 hp. Output speeds range from 280 rpm down to 6 rpm.

Complete descriptive information concerning Link-Belt Gearmotors and Motogears is found in a new 28-page Book No. 2447, just published by Link-Belt Co. It includes cutaway drawings of both types of drives, together with features of construction, complete selection data, load classifications, dimension tables, overhung load ratings and mounting assemblies. A copy can be obtained without charge from your Link-Belt district office or authorized stock-carrying distributor or by writing Link-Belt Co., Dept. PR, 307 North Michigan Ave., Chicago 1, Ill.

#### Diaphragm Valve

Straight-through flow with no dam to trap suspended matter is one of the advantages of the Wynn Straight-Through Diaphragm Valve, according to the Stockdale Engineering Co.

The diaphragm, made of flexible rubber or other material according to use, is molded in the "as closed" position to save maintenance costs by cutting down strain when the valve is tightly closed.

Available in a wide range of metallic and non-metallic body materials, in sizes from  $\frac{1}{2}$  in. to 14 in., for threaded or flanged connections, the valve can be used with pressures up to 250 psi according to size. The Stockdale Company also announces

that exclusive agencies and distributorships are available for reputable individuals and organizations.

For a copy of the new illustrated bulletin containing engineering drawings and dimension tables, write to Stockdale Engineering Co., Dept. 77, P. O. Box 144, Haddonfield, N. J.

#### **Dorr-Oliver Expands**

J. D. Hitch, Jr., president of Dorr-Oliver Inc., and John L. Merrill, president of Merco Centrifugal Co., have announced that Dorr-Oliver has acquired all of the business and substantially all of the assets of Merco Centrifugal Co. in exchange for approximately 50,000 shares of common stock of Dorr-Oliver Inc.

Merco Centrifugal Co., with headquarters in San Francisco, is engaged in the manufacture and sale, largely in the United States, of centrifuges, centrifugal screens and strainers.

#### **Industrial Battery**

Exide Industrial Division of The Electric Storage Battery Co. has introduced a new line of flat-plate motive power batteries to complement its Exide-Ironclad industrial battery line. Using the trade name Exide-Powerclad, they are described as pre-



mium flat-plate batteries with triple insulation. They are available at lower first cost and are for use in electric industrial fork and lift trucks, mine locomotive power and marine applications.

Further information may be obtained from Dept. PC, Exide Industrial Division, The Electric Storage Battery Co., Box 8109, Philadelphia 1, Pa.

#### **Welding Machine**

A portable welding machine designed specifically for manganese steel and hardsurfacing work on irregularly-shaped parts is being made avail-



able to industry after two years' field testing, the Amsco Division of American Brake Shoe Co. has announced.

The MF Welder, mounted on large industrial casters, is designed to plug into conventional a-c or d-c welding units by a single cable. The MF operates on a current range of from 150 to 450 amps.

As an accessory in the relatively new field of hardfacing, the MF serves as a semi-automatic device for feeding flux-coated welding wire to parts of machines, or implements, being "retreaded" with new metal after original surfaces have worn away. Unique features of the new welder include the self-feeding mechanism for keeping the welding arc constantly supplied with welding wire. Also described as special to the MF is the conical "hopper" mounted directly above the welding wire outlet as a means of storing and feeding flux. The flux adheres to the wire by the magnetic field created by welding current, and each one-quart refill from the hopper serves for 15 minutes of welding.

#### Lightweight Stoper

A new, lightweight stoper is now being marketed by the Le Roi Division, Westinghouse Air Brake Co., Milwaukee, Wis. The new stoper, the S-10, is manufactured at Le Roi's Cleveland plant and is designed principally for metal mining.

Weighing 79 lb when used with a 26-in. feed, the S-10 attains its fast cutting speed through use of an end-

seating valve. Another feature of the S-10 is the new "steel puller," which is optional equipment and the first available on any Le Roi-Cleveland



stoper. The "U" shaped steel puller, which swings on a pinion, can be raised to exert pressure downward, against the shoulder of stuck steel.

Operating on 70-90 lb of air pressure, the S-10 is available with 26, 32, or 38-in. feeds. An all aluminum cylinder and piston is used in the airleg. The diameter of the air hose is ¾ in., the water hose ½ in.

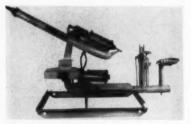
#### **Completes Compressor Line**

With the addition of a new 210 cfm Portable Rotary Compressor, Worthington Corp's. Portable Compressor and Contractors' Tool Division has announced the availability of a complete new line of modernized Blue Brute compressors which include the 125, 210, 315, and 600 cfm sizes. All types of standard mountings are available in all the Blue Brute sizes.

#### **New Hydraulic Monitor**

Newest development in hydraulicking equipment is a water monitor, said to be capable of throwing a 300-ft stream through a 2½-in. nozzle tip at the rate of 2000 gpm. The device, known as the Chiksan Intelli-Giant MH-4, is also unique in that its hydraulic controls can be manipulated safely and accurately with little effort.

The monitor has a horizontal sweep of 270° and a vertical range of 120° and operates with pressures ranging from 30 to 300 lb. Hydraulic power is derived from the pressures of water diverted from the horizontal supply



pipe near the intake. These pressures may be adjusted by control valves.

Second model of the Intelli-Giant series to be marketed, the MH-4 with its four-in. supply pipe and four-in. barrel is of lighter weight (650 lb) and of smaller dimension than its predecessor, the six-in. model MH-6. It features the same 270° tube turn barrel which serves to minimize friction loss and balance vector forces.

For remote operation, the hydraulic controls may be removed to a location far removed from the monitor.

#### Hard-Facing Material

A new nickel-chromium-boron-tungsten hard-facing material which provides parts exposed to extreme conditions of vibration and/or heat with a wearproof, corrosion-resistant surface is now available from Wall Colmonoy Corp., 19345 John R St., Detroit 3, Mich. Named Colmonoy No. 70, the new alloy has a high tungsten content which hardens the matrix, giving it improved heat and vibration-resistant properties, according to the manufacturer.

Originally developed to overcome fretting and fretting corrosion at temperatures of 1000° F and more on jet engine shafts, Colmonoy No. 70 is also recommended for use in engine valves, chemical valves, acid pump parts, coal washers and cement screws. It is available as a powder for application by Spray-welding or as welding rod in \$\frac{16}{16}\$, \$\frac{1}{4}\$, \$\frac{1}{46}\$ and \$\frac{3}{8}\$-in. diameter for application with an oxy-acetylene torch flame. It is also available as castings.

#### Hard Rock Drill

A new version of its Model 75 rock drill has been put into production at its Los Angeles plant, Thor Power Tool Co., Aurora, Ill., has announced.



To be known as Model 77, the new air-operated tool features a recently developed latch-type front head to assure a positive lock when pulling drill steels if mounted on a sinker leg. The new rock drill, which weighs 55 lb, is designed for drilling holes up to 20 ft deep in hard rock.

#### **Closed-Circuit TV**

Reduced costs through new technological developments are broadening applications of closed circuit television in all industrial and commercial fields, including remote TV viewing of coal levels in hoppers to assure a constant flow of coal from mine conveyors to surface conveyors. This was reported at the National Electronics Conference at the Sherman Hotel, Chicago, (October 3-5), by James L. Lahey, general manager of Dage Television Division, Thompson Products, Inc., Michigan City, Ind., manufacturer of closed circuit industrial television.

Lahey said the possibilities for closed circuit television can be more

easily understood if the TV camera is regarded as an extension of human vision, able to perceive and transmit to viewers miles or yards away scenes and information that cannot otherwise be readily or safely viewed.

#### **New Design in Coal Bits**

A new design in tool bits produced for mechanical mining machinery has been announced by Kennametal Inc., Latrobe, Pa., which describes the redesigned material—evolved over a perriod of several years—as a "radical" change.

E. H. Johnson, manager of Kenna-



metal's Mining Tool Division, said the newly-designed tool bits match recent boosts in the power and speeds of cutting equipment used in the mining industry. The tungsten-carbide material, it is said, also provides lower operational costs.

The major change is a relief panel design, which provides better side clearance and permits use of straight line secondary front clearance.

Johnson said "the high clearance angle offered by the new bits—which received extensive field testing—supplies smoother cutting while reducing power consumption." Also, with the top of the redesigned bit head at an angle, the carbide can be mounted with a normal rake angle more smoothly than had been possible.

One of the more practical advantages of the redesigned tool bits, according to Johnson, is that there is less steel to remove in regrinding. By reducing the amount of steel removal, there is a reduction in the time required to sharpen the bit—standard procedure dictating that the steel be ground before the carbide.

#### **Speed Reducers**

To meet many of the speed reduction problems encountered in modern industry, Link-Belt Co. has developed a completely new line of in-line helical gear drives, which combine a high degree of standardization with ability to stand up in heavy duty service.

Double reduction drives are available in ratios from 6.2 to 1 through 38.4 to 1, with capacities up to 118 hp. Triple reduction drives are available in ratios from 47.1 to 1 through 292 to 1, with capacities up to 20 hp.

#### Man Cage

A new custom-built elevator-type man cage designed and manufactured by Connellsville Manufacturing & Mine Supply Co., Connellsville, Pa., is now available to the mining industry. Already in use, the special double-

deck steel cage is designed and built to operate in a circular shaft. It is fully automatic with push-button operation.

Designed to

Designed to meet particular requirements and conditions as to cage, size and shape, speeds and depths of shaft, the packaged unit installed includes complete electrical equipment, cage with escape doors, counterweights, hoists, guides, rope, landing buffers, head frame with hoist house, landing

doors and housing, safety features and wired complete for push-button operation, lighting and telephone.

All parts can be moved by truck and it has been estimated that the cage, hoist and auxiliary equipment could be dismantled, transferred and reassembled in a new building in approximately 10 days.

#### Bit Detacher Modified

A modification in its BD-282 Bit Detacher has been announced by the Le Roi Division, Westinghouse Air Brake Co., Milwaukee, Wis.

Used to detach "one use" bits from drill steel, the detachers are now manufactured with a plate covering the bit and the end of the steel, a safety improvement over former models. The detacher can only be operated when the cover is in place, preventing injury from breakage or spalling of bits or steel.

The BD-282 detacher is used to remove Le Roi-Cleveland CRD and Vacnu-matic one-use bits.

#### **Vibrating Screen**

A new high-speed vibrating screen has been developed by Hewitt-Robins Incorporated, for the fine screening of such materials as sand, clay, fertilizers, chemicals, coke, coal, asbestos and detergents.

The new screen has a speed of 3300 rpm when set for a 1/32-in, stroke and 2400 rpm when operating on a 1/16-in. stroke. The maximum speed in the past has been 1800 rpm. The screen represents a completely new design, including a new lubricating technique

in which atomized oil is injected under pressure into bearings in the form of a fine airborne mist.

The new screen, to be called the HS Vibrex, is especially designed for use with screen cloth of 10 to 80 mesh. Under certain conditions it will be suitable for separations as high as 100 mesh. Wet or dry materials can be screened, and the unit is designed for applications requiring electrically heated screen cloth.

#### — Announcements —

George D. Fraunfelder, director of Engineering and Research, was elected vice-president-Engineering, and U. M. (Ben) Johnson, project engineer, was elected vice-president-Industrial Sales in a recent move by Easton Car & Construction Co., Easton, Pa.

Martin Vander Laan has been appointed manager of operations of the engineering division of Hewitt-Robins Incorporated.

Willis G. Scholl, a group vice-president, has been elected executive vice-president, Allis-Chalmers Mfg. Co., and Boyd S. Oberlink has been elected





W. G. Scholl

B. S. Oberlink

vice-president in charge of the Tractor Group.

Oberlink, previously vice-president and general manager of the firm's Construction Machinery Division, succeeds Scholl as group executive. The Tractor Group includes the company's Construction Machinery, Farm Equipment and Buda Divisions.

Dean C. Smith has been elected vicepresident of manufacturing at Thor Power Tool Co., Aurora, Ill. At the same time John A. McGuire, formerly vice-president in charge of labor relations, was elected to a full vice-presidency, and George A. Kautz, a member of the accounting staff, was appointed assistant treasurer.

Marion Power Shovel Co. has announced a strengthened sales organization in the southwestern states, headed by Dean Calland as Western Sales Manager. Two Divisional sales managers have been named to work with him in expanding sales and services in California, Nevada, Utah and Arizona. They are T. R. Fogelberg and E. J. Riggs.

John B. Shallenberger, president, Connellsville Mfg. & Mine Supply Co., has announced the election of Russell L. Lepley to vice-president and general manager of the company and Paul A. Doorley to vice-president and secretary-treasurer.

The appointment of J. F. Stedman to the position of controller to the E. J. Longyear Co. was announced by Robert D. Longyear, president of the company. Stedman will also retain his present title of office manager.

Don Dillon will assume the title of assistant office manager and chief accountant for the company.

The Dart Truck Co., manufacturer of heavy-duty, off-highway trucks, has recently announced the appointment of Walter C. Clayton as general sales manager.

Establishment of a specialized compressor sales division to service Western U. S. mining and construction industries, and appointment of Lincoln M. Knight to head the new section, has been announced by Atlas Copco Pacific. Inc.

#### CATALOGS & BULLETINS

HOW ZINC CONTROLS CORRO-SION. American Zinc Institute, 60 East \$\frac{1}{2}nd St., New York 17, N. Y. The book describes the many ways zinc lengthens the life of steel products and reduces maintenance costs. Drawings, charts, and photographs together with brief comments present the corrosion control characteristies of zinc coatings, zinc pigments, and zinc anodes.

HYDRAULIC ROTARY ROOF BOLTING DRILL. Joy Mfg. Co., Oliver Bldg., Pittsburgh 22, Pa. Bulletin C-50 describes the company's new RBD-15 Roof Bolting Drill. The 15-hp unit drills wet or dry, tightens bolts, and gives instant control, without a gear shift, of an infinitely variable combination of thrusts to 5500 lb at 1050 psi; feed speeds to 60 fpm; rotation speeds to 650 rpm; and torques to 240 ft lb.

SLING HANDBOOK. Union Wire Rope Corp., 2100 Manchester Are., Kansas City, Mo. New developments and popular demands have necessitated a new and expanded edition of Union Wire Rope's Sling Handbook. The book contains 60 pages of illustrations, charts and diagrams describing 16 different factory-fitted slings and nearly two dozen standard fittings available for slings. In addition it contains a complete rigger's manual, shop chart of proof tested ratings for all Tuffy Slings, a new engineer's note-book and standard signals for directing the operations of cranes, derricks and locomotives.

TURBODIESEL. Cummins Engine Co., Inc., Columbus, Ind. Cummins uses this 16-page four-colored booklet to answer the following questions: What is a Turbodiesel? What are the advantages of turbocharging? How does a turbocharger work? And how has turbocharging been applied to Cummins Diesels. At the present time Cummins produces five turbodiesels, ranging from 175 to 600 hp.

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| Read, Davis  Salem Tool Co.  Sanford-Day Iron Works  Sheffield Steel Corp.  | 15.<br>15.<br>24-2<br>4.<br>14-1.                              |
| Read, Davis  Salem Tool Co.  Sanford-Day Iron Works  Sheffield Steel Corp.  Standard Oil Co. (Indiana)  | 15.<br>15.<br>24-2<br>4.<br>14-1.                              |
| Read, Davis  Salem Tool Co.  Sanford-Day Iron Works  Sheffield Steel Corp.  Standard Oil Co. (Indiana)  Stratoflex, Inc.  | 15.<br>15.<br>24-2<br>4.<br>14-1.                              |
| Read, Davis  Salem Tool Co.  Sanford-Day Iron Works  Sheffield Steel Corp.  Standard Oil Co. (Indiana)  Stratoflex, Inc.  Thor Power Tool Co.   | 15.<br>15.<br>24-2.<br>4.<br>14-1.<br>16.                      |
| Read, Davis  Salem Tool Co.  Sanford-Day Iron Works  Sheffield Steel Corp.  Standard Oil Co. (Indiana)  Stratoflex, Inc.  Thor Power Tool Co.  Timken Roller Bearing Co.  | 15.<br>15.<br>24-2<br>4.<br>14-1.<br>16.<br>3.                 |
| Read, Davis  Salem Tool Co.  Sanford-Day Iron Works  Sheffield Steel Corp.  Standard Oil Co. (Indiana)  Stratoflex, Inc.  Thor Power Tool Co.  Timken Roller Bearing Co.  Truax-Traer Coal Co.                        | 15.<br>15.<br>24-2<br>4.<br>14-1.<br>16.<br>3.                 |
| Read, Davis  Salem Tool Co.  Sanford-Day Iron Works  Sheffield Steel Corp.  Standard Oil Co. (Indiana)  Stratoflex, Inc.  Thor Power Tool Co.  Timken Roller Bearing Co.  Truax-Traer Coal Co.  Union Wire Rope Corp. | 15.<br>15.<br>24-2<br>4.<br>14-1.<br>16.<br>3.<br>16.<br>28-2. |



# CORE DRILLING

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# THERE'S A BIG DIFFERENCE

# 4 Million\* Roof Bolts Per Month—Now Being Installed In Mines—

\* Over 3 million bolts in coal mines and 1 million in metal and non-metallic mines.

THE TREMENDOUS growth of roof bolting can be directly traced to the advantages it offers and gives the mines that have replaced conventional timbering methods with roof bolts. Roof falls that usually result in accidents, operating delays and clean-up costs have been reduced to a minimum. Safety records are greatly improved while increases in production run between 10% to 20% thus reducing the average cost per ton, per man.

Being the largest exclusive manufacturer of roof bolting products— PATTIN Manufacturing Company has the largest and most complete line of outstanding shells, bolts, etc. Our roof bolting experts are available for consultations and tests. Write or phone us at your convenience.

Shown above is the PATTIN style D-1 expansion shell. Samples of the "D-1" or "D-2" will be furnished upon request.

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PATTIN expansion shells are available and serviced exclusively through Colorado Fuel and Iron Corporation, Denver, Colorado. Western mining companies may contact them direct for information and consultation.

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Positive screw control moves bulb cradle for accurate spot-beam focusing.



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